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PUBLICATION

October 7, 1957 75 cents

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Standard
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Explores engine RPM
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BURNLY

1/11



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Aircraft Controls



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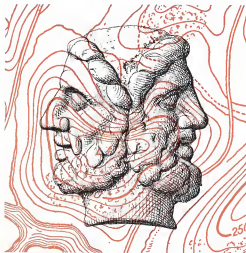
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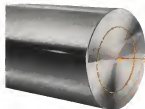
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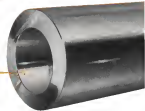
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OPERATING CHARACTERISTICS

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- Time constant 0.05 sec.
- Duty Continuous at 100%

The Edison Instrument Division has met the challenge of greater miniaturization in some motors for aircraft and missiles. The size 8 Gearhead Motor shown here is a typical example. Two pin locators Edison and can be supplied in any gear ratio within 2% and has the smallest diameter gearhead ever available. Add to this compact feature the fact that this unit gives the same output as a size 10 motor and you have an ideal motor for such construction in space as small gear mounting, instrumentation and small computers for aircraft. Its light weight also makes this gearhead motor easily adaptable for available work.

The Fulton Instrument Division now has this unit available in production quantities for fast delivery. Permanent tooling assures quality production of this small size and volume motor.

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TWA Hits the Comeback Trail

In seeking a pleasant respite from the cluttering typewriters of Ansonius Wren's offices on a dead-end day, we recently spent an afternoon flying around the eastern seaboard with Trans World Airlines' new president, Carter Burgess, vice of his staff and a quartet of the airline's directors as they held a board meeting in a newly styled Lockheed Model 1649 Jetstream some 10,000 ft in the air.

Most persons at this meeting were to acquiesce the decision with TWA's plans to carve out a large slice of the transcontinental market this winter. For as it was as approach, to really get acquainted with the Model 1649 and sense old friendships with some of the TWA veterans who did so much to educate me in the grueling discipline of instrument flying back in the early wartime days of the Air Transport Command.

Realistic Atlantic Nonstop

Talking with Bob Beck, a veteran pilot now special adviser to TWA's president on jet transport negotiation, and Bob Russell, engineering vice-president, we get the idea that the Jetstream has really proved itself in the transatlantic service this summer as a genuine westbound transport aircraft. During the three summer months TWA had 95% completion of westbound nonstop schedules between London, Paris and New York.

Back told of a September trip he flew after capturing *Reynardus at Bristol* in which he carried a full Jetstream tourist load of 75 passengers nonstop from London to New York under typical North Atlantic weathered weather. He had a mean headwind component of 46 kt and pushed up above sea level out of London that stand with him for several hours. He still had two hours gas reserve on landing at Idlewild. In the pilot's book, this is realistic serious westbound performance. Last week a Jetstream carried 44 passengers, covering 5,000 miles from London to San Francisco in 25 hr. 19 min.

Bob points out that while the excessive cruise of the Jetstream is about 15 kt slower than its fastest competitor in both the Atlantic and transcontinental runs it can do as good or slightly better than its fastest competitor because of the fuel ratio of climb that gets it to optimum cruise altitude sooner and a larger fuel capacity that does not require the lesser out engine and consequent retarded cruising speed of the long range cruise techniques necessary with less fuel margin.

Noise Control

Sitting in the noisiest seats in the Jetstream, just opposite the engines, with Bob Russell, we got a good demonstration of the effective soundproofing techniques applied to this aircraft. Even during takeoff Bob and I could converse with normal voice level and in cruising flight you can converse on conversations

close down the cabin. Soundproofing the cabin of the Jetstream costs 900 extra pounds of weight and is the result of a joint TWA-Lockheed research program on a Super-G Constellation.

In addition to the cabin soundproofing, propeller finish is reduced below audible level by synchronizing the Hamilton Standard propellers and using relatively low revolutions per minute that does little to speed noticeably. The Wright Turbo-Compound engines are also protected further out along the wing away from the landing.

The Jetstream is now the backbone of the TWA fleet and both pilot and management say they could use about double the 35 planes currently in service in the drive to establish TWA's competitive position on the key domestic and international runs.

TWA's "new look" program also involves new passenger service techniques and will lean heavily on the use of the pilot and flight crew as ambassadors of the airline's service. Flight crews will sport a new black and gold uniform next year and each captain will have a new red and white nose-painting livery on the leading wing that will identify him to passengers before they enter the aircraft as well as in flight. The new "Swire seats" are extremely comfortable for long range operations and combined with the soundproofing, soundproofing and good food and drink should set a new standard in first class passenger comfort.

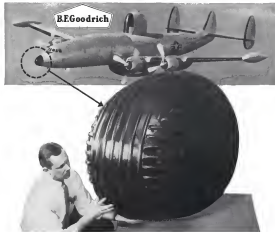
Food Service Improvements

Two touches in the food service are particularly liked. One is the technique of bringing aboard a whole beef roast, keeping it hot in an oven and then slicing it into serving portions as the meal is actually served. This makes a good meal indeed. The other is the choice of a full-bodied red French Mader wine that is a pleasant relief for people who enjoy fine food, although champagne is available for the type of person who enjoys the elegant luster of bubbles traditionally enjoyed.

It is pleasant to see who has known and flown TWA since the days of its Boeing 307s to see this old and fine airline come alive again under the touch of vigorous leadership provided in Carter Burgess. Although it is still much to early to assign a verdict on this new start-up, there are some tangible strides in the TWA wind. For the first six months its net loss shrank by about \$600,000 and in June a net operating surplus before taxes of \$4 million was posted compared to \$1.7 million for the same month in 1956. Third quarter figures should also be written in black ink.

TWA still has a long way to go to reapture the non-petroleum position it once enjoyed. But under Carter Burgess' leadership and bolstered by a hard core of seasoned veterans in the busy business TWA has definitely hit the comeback trail.

—Robert Heitz



Pneumatic De-Icers keep radomes clear without distorting radar signal



Shown in inflated position De-Icers will rub off ice and snow as air is blown into the spirals to provide distortion-free accurate bearing information.



Tubes inflate and deflate in alternate pairs to keep off ice formations. Actual is positive, dependable and simple.

GLANT radars designed the Navy's Lockheed WV-2, a vital link in our "early warning" defense system. Inside the bulb and in the nose are more than ten sets of powerful, sensitive radar receivers.

So building up on the large exposed areas of these radomes can find the radar signal. But lightweight BFGoodrich Pneumatic De-Icers, operating with compressed air, allow the radar to scan efficiently at all times, with no excessive loss of radar energy. BFGoodrich De-Icers also protect radomes from abrasion, erosion and fuel damage.

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Official United States Air Force photo

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World's Most Versatile Metal

The July issue of the Rem-Cru Review is devoted to quality standards. Ted Shuman, North American Division, is guest editor. Write Dept. A-17 for your copy.

WHO'S WHERE

In the Front Office

Julie M. Carter, president, Ordnance Technical Industries, division of Tecon, Inc., Beltsville, Md.

Donald D. Fiering, president and local chairman, the recently incorporated Fluorac & Kinney Engineering Corp., Northridge, Calif. Also Robert G. Kinney, executive vice president, Jon V. Hanson, secretary treasurer, H. Edward Glantz, vice president engineering, Charles Gasky, public relations counsel.

Berrett M. Patterson, president and a director, Belcor Research and Development Laboratories, Inc., Woodbury, N. Y.

John E. Ebb, vice president general manager and a director, Tidal Valve Co., San Francisco, Calif. Also Edward E. Martin, sales manager.

Leslie A. Wells, executive vice president, The Holst Arryth Company, division of Viste Corporation of America, Washington.

Dr. George E. Vaher of the Materials with Institute of Technology, succeeds Dr. Clifford D. Pridem as Chief Scientist of the United States Air Force, Washington, D. C. Dr. Pridem has returned to Princeton University as Chairman of the Aero Acoustic Engineering Department.

Col. Benjamin C. Bauman, Director of Research and Research and Development Command, Ballistics, Md. Col. Bauman succeeds Col. L. B. Williams as Deputy Chief of Staff for Operations, ARDC's Air Force Development Research Center, L. C. Haverhill Field, Bedford, Mass. Col. Paul M. Bauman succeeds Col. Holloman as Director of Air Weapons, ARDC Head quarters, Ballistics.

Mr. Gus Harshorn H. Horst, Director Arms Activities, Office of the Deputy Chief of Staff for Operations, Washington, D. C., has been assigned to Headquarters Eighth U. S. Army, Hawaii.

Paul Marshall, manager of customer relations, Washington, D. C. office, Corbin Division, Arms Manufacturing Corp., Omaha, Neb.

David A. Mott, assistant to vice president public relations, Air Transport America Inc. of America, Washington, D. C.

Honors and Elections

John S. Anderson, president of American Radar Inc., has been elected chairman of the Radio Technical Commission for Aeronautics, Washington, D. C. Mr. Anderson succeeds Dr. E. H. DeLong, retiring after 17 years as president. Dr. DeLong was elected to lifetime post of Technical Advisor on Administration and Operations from the RTCA.

Changes

Vincent A. Bookers, Jr. project control manager, Manned Space Program, North American, Inc.

Ralph S. Minton, director program configuration and market activities, Avco Corp., Andover, Mass.

L. A. Robins, chief engineer, Sverdrup Inc. & John Warkis Dryden, Ohio.

INDUSTRY OBSERVER

►Evaluation is under way at Cape Canaveral, Fla., missile launching site for substitution of undergunned equipment that will simulate ship attack. Equipment is part of launch complex for King of Navy's solid-propellant Polaris intermediate range ballistic missile. Operationally, Polaris will be fired from ships and submarines. Launch mast components for roll, pitch and yaw of the vessel.

►Third King of USAF-Corvus Atlas intercontinental ballistic missile will take place before the end of next month if the present schedule holds.

►Atlas reached approximately 15,000 ft in its second firing from USAF Mather Test Center, Patrick AFB, Fla. (AW Sept. 30, p. 30). First test model fired last June (AW June 17, p. 27) reached more than the 5,000 ft generally reported but less than 10,000 ft.

►Sikorsky S-61, helicopter-powered helicopter (AW Sept. 2, p. 25) is being designed for Navy with the ability to remain aloft for indefinite periods in the event of emergency landings on water. Airside has long-bell tail with spars. Leading edge of spars can be set at high angle of attack to aid in takeoff. Two-turbine engines, probably General Electric T85s, are mounted above the rotor, which will have span for approximately 24 persons. Sikorsky also believes the helicopter will have a commercial potential, particularly among offshore oil operators.

►Arrangements have now been completed for a number of static firings of its solid-propellant rocket motor designed for use on Navy's Polaris missile; first static. Since the rocket motor is not an integral part of the missile structure, it can be static fired in the missile surface and removed after launch, making way for a new motor. Unit is largest solid-propellant rocket engine built in the U. S. thus far (AW May 27, p. 23).

►North American Aviation Inc.'s long-range interceptor design for the Air Force (AW May 20, p. 37) has been designated F-105.

►Nose cone configuration for the operational Atlas has not yet been frozen. But, conceptual work performed in modified drawings (AW Sept. 2, p. 34) may not be the final design.

►Atlas missiles are being static test fired as a missile test stand at Edwards AFB, Calif., under base on Lockheed Ridge below shipment to Patrick. Missiles are put into position, while still on the carrying trailer. Trailer and missile are mated to vertical position together, then the trailer is lowered alone after the missile has been unmoored.

►Soviet Union has employed single additional communications for several years but a joint now beginning to investigate the possibilities of forward control.

►Piper Aircraft's 1955 models to be announced later this month will include new versions of the Apache (left) twin and Trojans (right) with increasing high-compression engines providing 16 hp more than the present 150-hp O-435s. Engines will improve the aircraft's maneuverability and payload weight capacities.

►Most important air navigation problem in Soviet Union today is need for improved landing aids. Aerial navigation at current ICAO meeting in Montreal has shown great interest in ILS and TFR-400 training class. Bunker Roma, co-ordinator for an system is still in one-directional beam and subcarrier channel leading. Only anticipated need for a long-range navigation system is for flights outside USSR's territorial boundaries.

►Washington's Gas Turbine Division is carrying out work on stress members for other divisions of the company in order to offset declining aircraft engine business.



World-wide maintenance for the F-27



Corporations operating Fairchild F-27's as executive aircraft can be assured of maintenance the world over. With more and more executives purchasing F-27's throughout the Free World, overhaul and spare services will always be nearby. The F-27's Roth-Weyer fleet proprietors are backed by a world-wide network of service facilities. Many corporations have decided that the F-27 is the aircraft to modernize their fleets. Cranking in better than 300 mph over a 3100-mile range, the F-27's superbly airborne executives with premium and air conditioned comfort. And no other aircraft of its type has the F-27's short-field capability.

For full information write to: R. James Pfeiffer, Executive Director of Customer Relations, Fairchild Engine & Airplane Corporation, Hightstown, NJ, 08520.

THE FINEST AIRCRAFT FOR AIRLINES, CORPORATIONS AND MILITARY SERVICES

Washington Roundup

Thor the Winner?

Probability is growing that the USAF Douglas Thor microelectronic range finding missile will go into production without any companion, meaning: with Army's Jupiter. Defense Secretary Charles E. Wilson is scheduled to enter the vote, and have announcement of the final decision up to his successors, Neil McMillen. In his Pentagon meeting, Wilson and last week, that a majority of the two systems would, the new development time and delay deployment of the final THOR. Wilson indicated that he and subordinates of the "missile" idea designed to solve the best of the two missiles, but overlooked the fact that the ground system equipment is both complicated and expensive.

The voting situation pointed out that less than 10% of the planned missile test range have taken place and that the resulting lack of information combined with the test, of appraising the ground system to complete the evaluation job.

Major unanswered questions: If Thor is chosen, how much more money will be spent on Jupiter's development and who will provide it?

Soviets' Satellite Secret

Russia intends to try nothing short of attempts to launch a satellite until now has been placed successfully in orbit. This is contrary to International Geophysical Year aims and Russia's own previously announced plans.

Soviet delegates to the CSAGI Rocket and Satellite Conference have begun last week in reporting other Russian statements that "sufficient" warning would precede launch attempts.

Russia has chosen 30,000 and 40,000 megawatts for satellite radio signals. U.S. delegates noted that this will require considerable modification of U.S. Mainland and other tracking stations and take several months for Soviet Delegates Sergei M. Palodov's statement over contractors' statements about satellite base of satellite and "sufficient" warning to other nations finally provided lightning, as which Palodov stated.

Later in the week, his delegation was saying there will be no pre-launching alerts. Any failures in attempted launches apparently will remain Russia's secret.

CAB Ethics

Which for the Senate Permanent Investigating Subcommittee to make a report within the next future calling for legislation to spell out a code of ethics for senators and staff members of Civil Aeronautics Board and other agencies. The report will be based upon hearings held last spring concerning an alleged CAB "look" on the decision to award a New York/Moscow route to Northeast Airlines (AW No. 13, p. 41).

At the hearing, Raymond Sawyer, associate director of CAB's International Division, presented testimony by Lawrence Bredesen, sales representative of Fairchild Airplane and Engine Co., indicating that Sawyer was the source of an advance look on the decision. At the time, Sawyer was executive director of CAB, and Bredesen was Washington representative for Trans American Airlines.

Sen. Elmer Jackson (D-Wash.), who presided over

the hearings on the Northeast case, already has introduced legislation establishing criminal penalties for both CAB employees who "look" confidential information and for individuals who attempt to "penetrate" Board members.

Tax Collector Collects

Bureau of Internal Revenue plans to continue collecting taxes on the "free" transportation aircraft and other defense items have provided new employees in an independent challenge by a U.S. District Court.

Most employees, it appears, are not aware that the rest of their move to a new location where it paid by the new employee, is taxable—until the Internal Revenue agent comes to collect.

The lawsuit's position, however, has been challenged by the U.S. District Court for the District of New Mexico. In two cases involving Santa Clara, the court maintained that Bureau of Internal Revenue collection of taxes on payments made by Santa to new employees from Kentucky and Texas were "illegal." The court said there was no intent on either the part of Santa or the employees to have "the non-taxable contract cost payments." The employees, the court held, "seemed unconcerned only for actual travel and moving."

The relocation sets for the convenience of the employees and did not constitute income in the hands of the employees.

The lawsuit is appealing the decision to the U.S. Circuit Court of Appeals.

Meanwhile, the tax collectors will continue to demand tax payments on the transportation and moving expenses paid by employers.

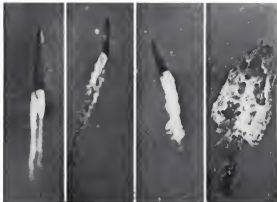
Fore Discount Cut

Dropping of the 10% fare discount on airfare travel by eight airlines may be an indication that the agreement with the airlines will be eventually dropped. The Civil Aeronautics Board, which has never been certain about the discount, has asked an investigation to determine the need for continuation of the discount program in the last May. As Transportation Agreement No. 5. As airline spokesman said it is a difficult task for the CAB would have withdrawn from the agreement if they felt the CAB would again approve the agreement since considerable airlines had would then be directed to reduce that continued the discount. The agreement was first awarded in 1949 to assure the gap between air and rail travel and attract more military travel on airlines. Now, however, rail travel has increased, and airlines claim the need for a discount no longer exists. Airlines who have formally withdrawn the discount are American, United, Trans World, Western, Southern, Midwest, Los Angeles Airways and New York Airways.

Airspace Control

Civil Aeronautics Board last week officially adopted an amendment to the old air regulations that will shift control of airspace over the U.S. above 28,000 feet. The amendment will become effective in Nov. 1 (AW Sept. 10, p. 45). CAB's amendment is the first step of a comprehensive plan for improved and expanded air traffic control.

—Washington staff



LATEST Atlas being hoisted from Cape Canaveral. The Canaveral launch complexed ballistic missile apparently was fired to give engine performance data, but it seemed they were sure and probably was meant for destruction when power went dead last July (AW Sept. 30, p. 38)

Missile Watchers Pierce Patrick Secrecy

Housewives, motel owners know what will be fired despite official pretense that all is shrouded.

By Evert Clark

Cocoa Beach, Fla.—Second test model of the Atlas I intercontinental ballistic missile lifted from its Cape Canaveral launching pad, rated to 15,000 ft., programmed over and was destroyed.

At a public beach seven miles to the south, reporters hurriedly raised binoculars and their ears and noted for the shots.

Several miles north of the Cape, news cameramen began dismantling the telescopic photographic equipment that had recorded the firing on film.

In the Pentagon and at Air Force Missile Test Center's headquarters on Patrick AFB, officials announced the missile had been fired.

Newspaper owners used the words "rocket," "bomber" and "guided" to describe what happened to the Atlas. They noted that the missile cost millions of

dollars. They quoted Assistant Defense Secretary W. J. McNulty's statement that the expense of developing ballistic missiles to an operational state "will be a good deal more than double the cost of developing the first atomic bomb."

A few streets and Air Force and Canaveral, the missile's prime contractor, felt the firing was not all failure because the missile did some of what it should have done, and valuable technical data was gained. These reports were unofficial. Officially, neither Air Force nor Canaveral could describe the "fired" reports because of security regulations.

Open Secret

Type of missile to be fired, its name and the approximate date of launching had been a wide open secret for many days despite the secrecy rules to the contrary. Even information about the objectives of this particular test was obtainable. Static fringes of the Atlas

engine a few days earlier had been visible from public rights of way for anyone patient enough to sit and watch.

A few months ago, the firing rate for larger missiles was less than one a month at Cape Canaveral. Now it is about one a week.

Word of preparation for a big firing spreads rapidly up and down the coast, particularly along between the Banana River and the Atlantic Ocean, and for an obscure reason.

Work at the \$360 million Patrick Cape Canaveral complex directly can cost 15,000 military, civilian and contractor personnel. Indirectly, it affects three localities, their neighbors, several surrounding Florida counties, and sea traffic over a broad, but shaped area 5,000 miles to the southeast and hundreds of stretch industry employees and military personnel stretching westward to the Pacific Coast.

An official release on the history of the Test Center states: "Because of the limitations imposed by security, very little can be said about the activities that are taking at the center." But neighbors and motel operators had seen

smoke and housewives do not read news columns.

Visible Propositions

Some indicate that "a missile" is to be fired in official. Red bells, visible from many miles at sea, are excited on 90 ft. poles at either end of the Cape on the day of a firing. If the firing is to be at night, red lights are used.

Two crash boats and three motorboat boats put to sea on firing days from a dock a few feet from a public beach. Observers who make a profession or a sport of missile watching know the time it takes the last boat out to reach its station on the range. Neighbors often take their breaks for lunch on the basis of such information.

Floods of permanent trucking camera operators on the Cape and along the beaches are called back only a few minutes before a launch is to take place.

Unofficial indicators of a big firing are as numerous as systems for betting the horses and generally more reliable. Each place has a favorite.

"You watch the waves," one man said. "When they come out to the beach with the lads and the housewives, you know they aren't here to get any time. They've got those already. They come out here and sit on the beach and listen." It goes and they get up and go home.

"You can tell when the missile's going to fill up with a little, usually over a weekend," another said. "The big shots only come in here for a good one."

When to Look

The simplest way to know when to go to the beach for "a good one" is to read the papers. Missiles have been big news to local reporters for some time—out on much because of a great technical interest in the science of aerodynamics or the strategy of war but because of the missile's impact on the



HOUSEWIVES, neighbors and motel owners are among the many knowledgeable civilians who know what is going on in the south of Cape Canaveral to witness firings. On at least two occasions neighbors have been questioned by security agents.



MISSILE WATCHERS lately focus on the beach where waves come in that a firing is about to take place. Fireworks has a system for predicting launch time. The area is too large to be completely protected from the eyes of uninvited observers.



SIGN OF THE TIMES in the Cape Canaveral area indicate that the presentational value of missile test operations is high. Many of the area's residents designed daytime signs since they often are illuminated by night.

USAF Sets Monthly Expenditure Limits

By Claude Wilson

Washington—USAF has assigned monthly expenditure limitations to 25 major contractors for the duration of Fiscal 1975.

The action appeared certain to force further streamlining of production schedules, employee benefits and a serious financial picture.

Major aircraft manufacturers at first glances estimated they will be forced to become cash-strapped as high as \$100 and \$250 million each before next June 15 to finance their production line under present schedules.

When these estimates were called to the attention of Defense Secretary Charles E. Wilson last week, he said these companies are being "starved" by the USAF order and that the capital rise could "cripple" in fact the critical production people on whom it is.

Wilson said it is his opinion that the aircraft manufacturers have a good credit in the present time.

No Leap Pay Delay

"It is not the Air Force's intention to have a pay delay in payment of its bills for the rest of this year," he said, "but it certainly sets expectations to get some temporary help from the government. The firms, if it is going to be aware the delay with commercial customers, may need that kind of help from time to time."

USAF and the action was taken on Sept. 23, p. 29) to limit the monthly expenditures to the fiscal year's expenditures be kept within \$27.9 billion. It was pointed out that this is only

about 75% less than last year's outlay.

Major contractors were asked to submit their estimates of billings to the rest of the year. Each firm then was assigned tentative expenditure limitations. Wilson said this procedure was used to assure flexibility and give USAF the opportunity to deal with individual cases without the restrictions of an arbitrary limit.

Production Adjustment

USAF Secretary James H. Douglas and Wilson said industry may have to adjust production schedules, but they expect renewed efforts to cut expenses and overhead.

At the same time, Douglas held the contractors in a letter they will be required to finance a higher percentage of the work in process out of their own funds. To this, Wilson added the possibility that a further reduction in pay rate payments will be made in the future.

Gen. E. W. Renshaw, chief of the Air Materiel Command, told for a contractor that the contracts by Oct. 18, showing the cumulative monthly amounts to be paid on each major contract for the remainder of the fiscal year.

AAC also will provide a breakdown of how much it can pay each firm by individual contract.

Wilson said the program gives to the industry by Douglas and Gen. Renshaw, contractors. The way the Air Force wants to do it. "Other way," he added, was to insist the military schedules downward by a lot or to order the industry on a day-by-day work. He said current compliance to the

aircraft industry is about 100,000 greater than it was a year and a half ago, indicating that he considers the industry payroll too large.

In addition to the program of layoffs, industry leaders were chiefly concerned last week with their financing problems.

In order to keep subcontractors in business and pay for the planned flow of materials, they anticipate making up substantial debt. Wilson said the program will be useful for the government to guarantee those debts or help the industry they will need.

Industry Reaction

Industry observers, coordinated by Wilson to be eye-catchers by the program, saw how often important leaders for their companies complained. One in the field, of only one major bank, said by its terms of this. A second is the possibility that banking accounts will close the least a year.

Each last week, members of the major companies were taking stock of their prospects. Most important contractors were with less luck.

It was clear that USAF and the Defense Department have taken the action as an effort to avoid any success for the administration to such an increase in the 1974-1975 debt ceiling established by Congress. Washington politicians, both at the Pentagon and outside, now believe it will not be possible to stay within the debt ceiling while there is no end to the Defense Department purchasing programs, particularly in the aircraft field, will affect further handouts. Congress is not expected to take action against the trend.

Employment Cuts

Washington—Additional job orders were totaling 1,200 and prohibiting the ending of Air Force Secretary James Douglas's letter, severely spending savings have been announced by North American Aviation Inc. and General Electric Co.

North American's Columbus Division will eliminate 5,300 jobs by September and layoffs by the end of next March. Total by the end of March is expected to be 9,500. Production of the USAF F-100 and the Navy F-4 and F-16 will phase out in the next few months. Navy's F-16 and A-10 are in testing and production stages of Columbia. The division also has canceled programs for Navy, Marine, USAF and Army components and "a continuing combat effort in various combat fields," North American said.

General Electric's Aircraft Co. Turbine Division at Evendale will cut 1,200 jobs in its production repair department and 200 in the next few months. Navy's F-16 and A-10 are in testing and production stages of Columbia. The division also has canceled programs for Navy, Marine, USAF and Army components and "a continuing combat effort in various combat fields," North American said.

At his last press conference in chief of the Pentagon, he revealed that department expenditures in September—the current month—were about \$3.5 billion for regular functions and the Military Aeronautics Division. This is a drop from \$3.4 billion in July and \$3.4 billion in August.

Wilson said his preliminary estimate of expenditures for the first quarter of the fiscal year will be close to \$10.4 billion at \$10.4 billion more than planned. He commented that the September rate was encouraging. "We lost no more ground in September and maybe gained a little."

Actually, the September rate was at about the 1974 billion level set for the year. It follows that unless for the rest of the year we stay within the limit.

Aeronautics Expenditures

Aeronautics System, Inc., Ford Motor Co. subsidiary, has large expenses from its temporary quarters in Glendale, Calif., acquiring a 600-acre site at Newport Beach near Los Angeles with option to an adjacent 160-acre site. Construction will begin next week to house an integrated facility for engine and materials laboratories, weapons engineering activity and prototype manufacturing of its own equipment and possibly other.

Aeronautics is moving there because established at its new location in order to support a prototype project.

French Aircraft Industry Gains Threatened by Drastic Cutbacks

By Robert Frazer

Paris—French aircraft industry is threatened by important budget cuts that which will result in severe cutbacks and uncertainties of current production models as well as complete abandonment of several advanced prototype aircraft.

Budget reductions are being imposed as a result of French efforts to give to such government spending as possible. Reductions are being imposed on defense industry contracts that such action will put about 100,000 out of the program under by industry over just decade, progress achieved by aviation world of the Paris in June.

Still Uncertain

Reduction, which were accepted by Army, dominated French Defense Ministry last August, are not yet official. However, lack of French government leaves little doubt that such actions will be decided in opinion as to whether new government will push its own case.

According to informed sources, present budgetary proposals on such models in Sud Aviation Dugan and Aerospatiale helicopters will be slowed down to an average one-third. Some think it probable the Sud Aviation Dugan, Dassault Mirage III and Nord Northing transport.

This means just as French industry is beginning to look at old problems—getting back production rates in order to pay for the government's budget cuts are going to be kept out of the program. For example, Nord company presently is reaching monthly production rate of 10 with its Nord cargo transport. It will be a slow-down in the future.

It also is understood that on Vautour and Super Mirage series, budget cuts will result in the shutting out production line but also for reducing its rates. Orders in both these aircraft are not being cut back either due to new second schedule 75% completed. Case now has been told it probably won't be able to complete the second prototype.

As for airlines, present budget cuts appear to leave old projects standing untouched. Some is true for Sud Aviation Canard. Though not ordered by military, it still needs government support in order to get production going.

assembly of Sabre. Budget officials estimate that as a result of the cut back, most cut of the four aircraft nearly completed probably will equal total cost of about 15 aircraft. Only recently Air Force decided Sabre in steel wings aircraft for French Union aircraft.

All production and production orders for ground support "police planes" for use throughout French Union are canceled under the budget. Reductions also are being imposed on projects like SIPA, 1100 and Mirage, Sabre 1100, models of which were displaced for first time in recent Paris air show. Also canceled are older projects like Puma 75 and Mirage 710.

Budget cuts on the Trident and LeDuc program may be maintained to the abandonment of each project. Also eliminated is Sud Aviation's new super-sound "bomber" Super Vautour, which currently is under production.

The original production order for 20 Tridents has been cut back to two. The more advanced Trident comes in no response. For now, four French Air Force has been given preference over Dassault Mirage III over than Sud Aviation order for powered Trident interceptors. Cancellation of Sud Aviation's most important business, the Super Vautour, has caused French in France circles are the other hand. The move is being interpreted as another victory by Dassault, a little company, his supreme business, Mirage IV, in prototype stage. Little aircraft status emboldened by budget cuts.

Design Group

Possible disappearance of the Trident project plus cancellation of Super Vautour has thrown a shadow over the future design and research body at Cosmelec near Paris. This group is now in Sud Aviation but is more or less without for Air Ministry. Responsible for such projects as Trident and Super Vautour, the group is Cosmelec now is abandoned.

Another shock for French aviation circles is the new action by budget cuts in LeDuc cargo program. First LeDuc 621 model in aircraft is now second schedule 75% completed. Case now has been told it probably won't be able to complete the second prototype.

As for airlines, present budget cuts appear to leave old projects standing untouched. Some is true for Sud Aviation Canard. Though not ordered by military, it still needs government support in order to get production going.

Where Expenditure Limits Hit

Washington—Following is the list of 25 major contractors assigned monthly expenditure limitations by USAF for the remainder of Fiscal 1975:

- AC Spark Plug Division, General Motors Corp., Flint, Mich.
- Aerojet-General Corp., Azusa, Calif.
- Allison Engine, General Motors Corp., Indianapolis, Ind.
- Budd Aircraft Corp., Wichita, Kan.
- Bell Aircraft Corp., Buffalo, N.Y.
- Boeing Aircraft Corp., New York, N.Y.
- Boeing Aerospace Co., Seattle, Wash.
- Boeing Aerospace Co., Wichita, Kan.
- Collins Radio Co., Cedar Rapids, Iowa.
- General Electric of General Dynamics Corp., San Diego.
- Curtiss-Wright Corp., Woodbridge, N.J.
- Douglas Aircraft Co., Santa Monica, Calif.
- Fairchild Zivko & Airplane Corp., Binghamton, Md.
- Federal Technologies Laboratories, Norfolk, Va.
- General Electric Division, Ford Motor Co., Chicago, Ill.
- Hughes Aircraft Division, Hughes Tool Co., Culver City, Calif.
- Military Production Division, International Business Machines Corp., New York, N.Y.
- Lockheed Aircraft Corp., Burbank, Calif.
- The Martin Co., Baltimore, Md.
- McDonnell Aircraft Corp., St. Louis, Mo.
- Western Electric Co., New York, N.Y.
- General Electric Co., New York, N.Y.
- North American Aviation Inc., Los Angeles, Calif.
- Northrup Aircraft Inc., Hawthorne, Calif.
- United Aircraft Corp., East Hartford, Conn.
- Bode Corp. of America, New York, N.Y.
- Lockheed Aircraft Corp., Burbank, Calif.
- L. I. N. Y.
- Spry-Guyette Co., Great Neck, L. I., N. Y.

Traffic Control Experts Loaned To Airways Modernization Board

By Philip J. Klass

Wilmington—First details on organization of the Airways Modernization Board and the new agency's program to date were reported here at the fall assembly meeting of the Radio Technical Conference for Aeronautics by James L. Asari. Asari is acting technical director of AMB.

Airways Maintenance Board staff now number around 78, of which about 34 are professional personnel. Board expects staff to reach 60 within several months, ultimately to grow to about 100, including persons requested to operate agency's proposed experimental facility, Averb said.

Aerways Modernization Board has been able to obtain some of nation's top traffic control experts from military and civil agencies on a temporary duty assignment basis. To allow air forces find the agency will go on without the developments without adequate consideration of our needs. Aerway said that present staff includes six traffic controllers, three licensed private pilots, six military pilots and two civilian pilots.

First Project

First of the Army's Modernization Research programs, officially launched last week, is assembly of an experimental automatic data processing and display system, using existing state-of-the-art, for delivery in January 1970 (AW Sept 22, p. 20).

Next AMR programs to be initiated will deal with support configurations. Research Agency is drawing up a program of subsonic and flight experimentation to be conducted during next 12 months to provide data for design and construction.

nion of high-speed turnoffs and associated lighting, Anst reported. This construction later will be expanded into full airport configuration research programs which will include parallel runway locations, parallel short runways for private aircraft use, bi-pass strips and optimum locations, and configuration of adjacent airports, Anst said.

Board's Organization

Arrows Modernization Board's efforts will be carried out by four task committees.

- Operations analysis branch will conduct continuous cost-accounting-analysis program in the field to determine where specific runway lighting improvements are needed and to forecast user requirements. This will pinpoint areas where research and development activities are required.

• Systems analysis branch will analyze new systems proposed by user groups, weapons manufacturers, or by an ASST Systems Engineering Group consisting of senior personnel from all branches, in outline and select the more feasible ideas.

*Systems experimental branch will plan and direct evaluation of the new promising air system accomplished by the Systems Analysis Branch. Tests will be conducted at proposed AMB experimental facility, at military or civil agency facilities, or at an outside contractor's plant.

• **Component development branch** will provide pool of technical experts in various skills required for developing new mission facilities. This group will direct ASIB contractors in their development programs, will also closely monitor Defense Department developments in

Infrared PWI Tests

Fare major carriers plus flight test evaluations of new AirportGrounds is based aircraft presently serving indicate, beginning early in 1990. (AVR Aug. 12, p. 77). United Air Lines will install the system on a Boeing 747, Pan American on a DC-7, American on a DC-7C, and TWA on Eastern as a Constellation. AirportGrounds expects to begin initial flight tests on company DC-10 in November.

be sure that new state-of-the-art is quickly applied to the Common Services and to prevent or quickly resolve TACIS/DMM-type conflicts.

Direct Contact

User groups that want to introduce their formal representations to ANS will be able to do so directly without having their policies and desires filtered through a series of panels and committees," Aant and When ANS needs to coordinate matters of interest with user organizations, "it is expected that the Board will confer directly with officials of these organizations," Aant said.

New signs suggest to manage its own research and development program without outside assistance, Amstar told. However, to keep the management workload to a minimum, AMR plans to award only a limited number of contracts for major research of its extrinsic research and development program.

Ramey Tells Industry To Stress Simplicity

Fort Worth—Military engineers plan, carry out the aircraft missions, carry out the solutions to problems of the future which encompass weapons, performance with a degree of simplicity that will allow a feasible cost level, according to Lt. Gen. Roger M. Bunker (USAF, Ret.)

Gen. Ramesh, who retired as vice commander of the Air Defense Command in January, said that both Defense Department and industry must acknowledge that the greatest technological advance must be achieved, not in terms of advance, but in terms relative to costs. "Project analysts planning across the proper interface between defense and transportation," Gen. Ramesh told a meeting of the Trust sections at the Institute of the Aeronautical Sciences.

Pointing out that costs are increasing rapidly with advancing technology and performance requirements, Gen Ramsey observed that new developments are being exploited principally to achieve higher performance. He said

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IN SUPPORT OF FREEDOM

Four Royal Canadian Air Force squadrons of CF-100s are now in service with NATO in Western Europe. Once again Canada has demonstrated its capability of meeting its commitments to its allies in defence of freedom, on schedule.

Additional squadrons of CF-100 interceptors have been ordered to augment the all-weather, round-the-clock defences of Belgium.

AVRO
AIRCRAFT
LIMITED
 MALTON, CANADA
 MEMBERS: A. V. ROE CANADA LIMITED &
 THE HAWKER SIDDELEY GROUP

Formation flight of rocket-armed CF-100s



As R.C.A.F. Squadron prepares before take off to base in Europe.



Pilot and navigator ready-up for trans-Atlantic flight.



that, if all weapon systems for which there was to be a demonstrable requirement and which are technically and economically feasible, are covered through to procurement and operation, total defence costs will mount to an explosive rate.

Some nations must be ignored. Russia and, since, if the capacity of the national command is limited to it, since the defence effort and the short is compared to the scale of capital requirements, a tremendous deficit thus results.

Gen. Ramo observed that, in the future as well as right now, some feasible solutions to defence problems will have to be deferred, stretched out or discontinued.

Gen. Ramo, now a Fort Worth research executive, suggested four areas in which the current debate could contribute to solving those problems. First, he said, is in the field of guided missiles.

For tactical reasons, missiles offer the best means of delivery, although Gen. Ramo emphasized his view that missiles are not wholly replace manned aircraft at least in the present state of the art.

The targets whose location is known, Gen. Ramo said, long range missiles like the Northrop Snark offer the lowest cost means of delivery. Costs also are not as dependent of air defence assets which "not down some of the extremely costly high performance de-rivatives of the fighter."

Modernization of weapon systems is another potential field for cutting costs. Gen. Ramo said, as weapon systems become more costly, the output can afford to bring fewer and fewer of them into operation and use them to good falling behind in the technological race to develop greater potential only a weapon since it is fast under development, he said.

Third, establishment of air-out-cutting effort is "a combination of and emphasis on a broad scientific and technological base for operations." Gen. Ramo said, and two examples of the results of such an approach are increased thrust weight ratio in the new small jet aircraft, new studies development and borders lower cost.

Gen. Ramo suggested that the fourth area for cost cutting lies in the use of newer and technology to find simplified solutions to defense problems.

It is the final movement of progress since that results in disproportionate large increases in complexity and cost he said. By utilizing skill of the art techniques to control his activities, "it will be possible of a reduction in cost, say, 5% and effectiveness to real use a savings of from 40 to 50% in cost."

Technical Merit of NavAids Bows To Pride, Politics in ICAO Talks

By JAMES A. FARR

Mortimer-Pride, politics and cost control competitors are dominating discussion here of both long and short range navigation systems, blocking resolution of implementation of any system internationally in the immediate future. Discussions are part of talks on Communications Division activities of the International Civil Aviation Organization.

Basic conflict is between Great Britain and U.S. over philosophy of area coverage versus the area system. British, with strong support from commonwealth participants, are pressing for an early international conference to evaluate short range systems.

But long and short range navigation systems, for British, their short range aid is presently in use and Great Britain aid is expected to complete trials within the next nine months (AV Feb 15, p. 73).

U.S. Viewpoint

U.S. delegates in meeting are more for an early international conference because domestic evolution of the short range, ground based system, it has previously NavAids, Loran C (Orbit) and Omega is not expected to be limited for three to six years.

In short range aids, U.S. is supporting the previously adopted VOR/DME (Distance Measuring Equipment) system modification, U.S. VOR/DME modification, U.S. VOR/DME modification, U.S. VOR/DME modification.

British position on both long and short range systems has been given in a working paper presented in the meeting which states:

It seems quite clear that the time has come when the entire question of navigational aids must be completely reviewed in order that a solution can be found which adequately meets the current problems of the high performance aircraft.

The United Kingdom recommends most strongly that a special meeting of ICAO be convened, at the earliest possible date, to give due notice the consideration of demands.

Committee studying long range aids is expected to adopt a proposal of the American delegation to put the problem of low altitude aids, which will be evolved to ICAO's permanent Air Navigation Commission, and to ask the commission to determine aspects of implementation. If this is

done, U.S. is expected to step on its right against an early meeting through its representation on the commission.

Implicated U.S. delegates also want range aids to the expanded VOR/DME system is adequate to meet all present day problems of U.S. domestic air operations. Across the North Atlantic and other high density, long haul routes, major U.S. communications through planned service with plans improve ground communications being believed to be capable of providing adequate air traffic control for the next five years. The U.S. is developing and implementing a satellite navigation system.

Observers present from two other international organizations have accused the agency from their points of view of an early solution to the long range and control. A representative of the International Telegraph Union told the subcommittee considering the long range aid question that it might take up to five years to clear the band of frequencies—for example, the 90-110 MHz band used by NavAids and Loran C (Orbit)—on an international basis.

The International Telegraph Union representative said that if a decision is to frequencies required was made in time, it could be brought before the Feb. 1959 meeting of ITU, but that the next international meeting of ITU would not be before 1965.

U.S. delegates told the subcommittee that the NavAids Work that he did not learn of any stations presently using the 90-110 MHz band on a permanent basis.

The ITU representative said, however, that there are between 20 and 30 fixed maritime and aeronautical stations, operating with power up to 25 kw, using this band at present.

Pilots' Viewpoint

A representative of the International Federation of Air Line Pilots Associations told the subcommittee that his impression concerning the need for a long range navigation aid is both sympathetic and urgent.

In an informal discussion after one of the meetings, the representative, a pilot for BOAC, commented to name of the delegates that the pilot's point of view is not that would do only 50% of what the delegates intend would be added a modified one because of the broad area of the work where there is much no satisfaction and the pilot's viewpoint is different, he said, because the pilot "usually consider himself to be the key man at the time of an accident."

Tight Money Threatens Jet Stretchout

Airlines' ability to meet re-equipment loans, make new ones to be major issue in fare investigation.

By L. L. Doty

Washington—Possibility that airlines face a stretchout of their jet transport re-equipment programs will be a pivotal issue in the Civil Aeronautics Board general passenger fare investigation to be started next month.

Some carriers already are showing great concern over the industry's ability to finance the more than \$2 billion considered for future aircraft unless the continuing trend toward unimproved profit margins is reversed (AW May 13, p. 7). The last signs of failing a number of airlines to take a second look at their jet equipment programs. It was a significant factor in Capital Airlines' decision to halt its latest equipment program of DC-9s.

Observers point out that a few of the long-range lines already confront with large interest companies or bank groups to be committed under the credit support trend in order to allow the airlines to meet such specified costs as minimum working capital positions or fleet debt/equity ratios.

The credit backing, coming in the wake of the Civil Aeronautics Board review of interest rates, is viewed by some as a means to avert a serious fare increase (AW May 12, p. 38), since loans at market rates that, although interest rates rising, the interest is not sufficient to offset the rapidly climbing expense level. The review claims that only a fare increase can correct a situation which American Airlines terms the "worst passenger earnings position of the domestic airlines."

CAB Stand

A completely opposite stand has been taken by the Civil Aeronautics Board in its split decision in the suspended re-equipment program of the Boeing 747.

There is no evidence as yet of any mobility on the part of the trunk line industry generally to obtain necessary financing for replacement or expansion needs.

Nevertheless along the route between these two views stand a number of financial difficulties outside the civil aviation industry who are utilizing the jet equipment program model. Although not so threatened as their own on the subject as airline officials, this group warns that domestic carriers are in a

relatively weak position to compete effectively for funds in today's highly competitive and tight money market.

Some airline executives feel the carriers might have met with some success in this period for an emergency loan increase had they realized the support of these outside experts in order to present an unified and objective picture with the problem. In fact, the CAB expressed its decision that "no industry was offered from members of the financial community as to the level of earnings the carriers would require in order to obtain additional financing."

'Unsupported Assistance'

CAB member Louis J. Hertz stressed that point in a recent concurrence of the Board opinion by charging that airlines' failure by the subject failed to prove the need for a fare increase to produce sufficient earnings to back jet programs.

"In general, the current cost out on the suspended portions of their own carriers, at an immediate fare increase is necessary for them to complete their equipment program."

The Board still concluded that the airlines "failed to support their contention that a fare increase is required in order to avoid access of not negligible damage to their credit status."

United Wants \$80s

Chicago—United Air Lines hopes to produce the Carrier 800 freight transport for medium range operations at substantial financial arrangements on be considered. The order would be the first phase of its future re-equipment program.

Earlier, United had shown strong leverage over the Lockheed L-100 to replace its Carrier 140s. However, company officials later decided to order jet freight to an all-transport operation.

United has a total of 50 DC-10s on order at an approximate cost of \$10,000 each. As of Jan. 3, commitments for the purchase of medium freighters and equipment totaled \$193 million under an expansion program scheduled to extend into 1983. Major freight contracting by the airline involves the sale of up to \$120 million of 44 existing load factors to these life insurance companies.

Victor Chizzara, Chairman, Garner, the line director in the case, expressed concern that the denial of the United's bid increase places the airlines in a "critical financial position." He referred to the tightening profit margins which he said "make it impossible for the airlines to finance with after industry for necessary capital to complete its equipment program."

Garner's views were echoed by one member of a Wall Street financial firm who told Aviation Week that public equity financing "will be extremely difficult if not impossible" unless an improved gross margin status is maintained. He also said the carriers' relatively soft financial position (as he attributed to the low market price of airline stock compared to the book value).

At present, airline common stock has dropped sharply from 1973 levels and, at almost every cost, has fallen below per share book value.

For example, Northwest common stock was quoted on the New York Stock Exchange early last week at \$18, a decline from the 1973 high of \$26, although book value has climbed to over \$100 a share, \$23.95 on Jan. 1. Silverman put share of common stock has doubled since 1972.

Under such conditions, new stock sales for equity financing are not likely to be successful. The approval of stockholders since such a procedure will give new stockholders a greater per dollar share of the airline's assets than old stockholders possess. This airline's sole market-based capital source can have a dissuasive effect on bankers in giving a carrier's ability to take on a heavy financial burden.

Airlines contend that the 6% low financing would have increased significantly in possible a low rate of return on stockholders' equity and present a sufficient yield to attract investment. An improved lever financing ratio, they say, would result from a fare increase. United has the market/book value ratio of stock issue normal alignment to present a stronger base for equity financing.

CAB has indicated that the 6% low interest would add approximately 507 million a year to domestic freightline airline revenues. American has estimated that the airlines in current that \$700 million in the capital funds needed to support jet equipment program this far.

Although a number of airlines have completed arrangements for future long-term loans to cover their air equip-

New York—British shutdown of two of its Trident 783 engines in flight over Florida last week did little to ease the problems besetting the British firm. Trouble was mentioned and out the manufacturers there not believe it was connected with wing difficulty encountered in the other Trident 783 engines.

The British Overseas Airways Corp. Britannia 312 landed at Miami International Airport on two engines after running into trouble at about 12,000 ft. on climb-out and isolation. Plans which called down 10 BOMAC and British technicians, had arrived at Miami after a trouble-free transatlantic flight. BOMAC was taking it to the Caribbean in part of a program program during which special atmospheric conditions connected with previous flights were to be tested.

Incident, which occurred about an hour out of Miami, was definitely not a case of flutter, liquid fuel, Number 2 and 4 engines were shut down while high altitude temperature decreased. No damage to parts were found, including wing, was not a factor.

Flare was out at Miami last week and its engine were being moved for shipment back to British for study. When further trouble occurs in one it has in hand with another, then again under way. Incident last not affected BOMAC's plans to begin service with the long-range Britannia next year, a statement said. Plans after further testing for British investigation before clearing any plans.

British had agreed to purchase delivery of Northwest Airline's Britannia until last fall, but the deal was subject to inspection. The helicopters were delivered too long for the 1978-80 program, and the airline must wait first delivery between January 1980 and 1981.

"I'm not sure now," before the contract was to be signed with the full delivery date, a British spokesman said. British will in all likelihood be losing from the postponement.

ment program, investment firms put out that such contracts are only open, before the books are made in a profitable. Most airline financial programs, which include long-term loans, are coupled with depreciation benefits, proceeds from the sale of old equipment and retained earnings. Some airlines have established their ability to repay the loans according to retained earnings, but they have an option to make the projected debt service payments out of one of the terms for most long-term loans. In addition, working capital must be held at a minimum level as a request must.

As an underwriter explained, when earnings began to decline with respect that the project is not unimportant, banks will review their financial programs with the possible result that the airline is question no longer qualifies for the loan under its original terms or conditions.

According to W. H. Macdonald, a partner of Stern, Stern and Co., New York, brokerage firm, airlines will remain in an "extremely unattractive" position to undertake any equity financ-

ing the airplanes and both retained loans to the beginning that early delivery was a big gamble and both stood to lose if Civil Aeronautics Administration required such modifications. Plans will not be modified in CAB until a permission is received for the long program.

Northeast routes at Britannia at their original price about \$100,000 under that for today's customers, and some new ones in, based on pricing input data costs, at had been previously agreed.

Plans for the future to meet Northwest's delivery schedule will be based on CAB requirements. British will try to meet 144 modifications, including structural in loading gear, the strengthening of wing, emergency exits and lightning strikes. Rebuilding some airlines with BOMAC, Britannia 147s, British Managing Director, Peter Mansfield and the new ones Britannia. Only 10 Britannia scheduled in 1980, Britannia 302 flights, he said. Only one engine at a time was involved, an engine was not more than 10 seconds, and there was some to stand by.

Three problems for a presentation to the Board, being tested. Mansfield was an application of test to the rest of the fleet, one of "three engines" multiple tests to distribute test, and modification of both airlines.

Whether the program modification is, Mansfield said, it will be limited to emergency and will not involve any stand alone delivery delays.

The Britannia has embarrassed its manufacturers in the track of its engine problems. When the second prototype developed fire in No. 1 engine and was crash landed in a field that on the Keweenaw Peninsula in July 1984, two members of KLM Royal Dutch Airlines were killed by a disintegration. Early this year a Britannia developed engine trouble on route from Vancouver, B. C., to Toronto and turned back, carrying Canadian Pacific Airlines President G. W. McCannock among its passengers.

as long as earnings are down and steady prices are "highly off" (Bridging the gap, the third test, it added that during the past seven years, all carriers except Northwest Airlines have solved earnings that "as an extent of the 8% standard demand for and reasonable, reasonable, 8.14% for TWA to 12.6% for Delta."

Need for Income

On the first, CAB and in its decision on the application for a 6% fare increase that the need for such as income depends on whether carriers have provided and will provide a fair return on the investment in added cost of fuel. In addition, it added that the fuel factor in this decision rested on finding whether recent and recent depressed earnings were due to short lines factors.

The Board and evidence in the case showed that the airlines "have had substantial earnings in the past" and that this condition will continue in the future. It said that an 8% return on investment had been selected in "the context, reflecting a part and considerable level of earnings" and charged the airlines with submitting a dollar amount of earnings without suggesting any particular rate of return.

Average rate of return of the truck-line carriers for the period during which

then have been subject to the Civil Aeronautics Act of 1978 has exceeded 8%, the Board said. It added that during the past seven years, all carriers except Northwest Airlines have solved earnings that "as an extent of the 8% standard demand for and reasonable, reasonable, 8.14% for TWA to 12.6% for Delta."

During the case, the airlines protested against the inclusion of capital gains in the determination of fair rates of return. It added that such returns were irrelevant, non-recurring and a type of measure that is plucked back into new equipment.

The Board countered that "if the current capital gains are irrelevant and non-recurring as claimed," little, if not, intention of the average earnings model result from the inclusion of capital gains." It concluded that there are other characteristics of other assets, the earnings reported by the airlines have been substantial."

CAB held that the present decline in reported earnings is attributable to short term factors. It demanded the airlines' position that depressed earnings are due to structural competition and

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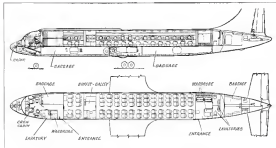
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FOR MEDIUM RANGE: A. D. F.



FOR SHORT RANGE: VHF FOR VOR/ILS Communication



DIAGRAMS show passenger and crew accommodations on the Ilyushin-18 Moscow

Titanium Used on Aeroflot's Ilyushin-18

1,640,195 lb., depending on gross weight of the particular aircraft.

Aeroflot indicates that the mechanical design of the propeller is an advance over all existing types. Radial pin construction around the prop hub because of its light bearing loadings on the hub ends. Wind cannot then propeller when the aircraft is stopped on the ground because of a built-in lock.

The Moscow has sufficient power to take off fully loaded at one engine idle during the takeoff run, and can also maintain level flight on two engines. The climb distance at maximum gross weight under normal conditions is 2,795,740 ft.

This is impressive when compared with the DC-7C, a transport of similar weight and dimensions, only 1,900 less horsepower. It needs approximately 5,600 ft. to take off at maximum gross weight.

Aeroflot reports that the new Ilyushin transport can be operated into all of the airports in its domestic routes. Some of these fields are known to be unpaved and Aeroflot attributes the Moscow's rough field ability to low takeoff and landing speeds, and to a 29.5 ft. spread between the main wheels to make cross wind landings easier. Each one of the main landing gear has four bogie wheels and can support the aircraft if one wheel on each side is jammed.

Construction and layout of the Moscow is conventional, its external appearance is somewhat similar to the latest Douglas piston engine transports. Features of its aerodynamic construction

and its landing hook down into two sections. The forward section is by far the largest (91 ft. 10 in. long) and contains all of the pressurized area. Design of piston cabin and its effect on the rest of the aircraft have received special attention, according to Aeroflot. The most vital parts have received "double strength."

The wing is straight with a trapezoidal shape and has a 121.7 ft. span. It consists of a root panel and two detachable tip sections. The three area center panel is about 71 ft. long. The fuselage engine nacelles, main landing gear and flaps are attached to it.

The fuel tanks are also located in the wings. The sections in broken down into two structural groups, one each for the right and left engine groups.

Control Surfaces

The empennage is of metal with sections of swept trapezoidal shape.

Control surfaces on the aircraft are not powered in keeping with a general Aeroflot belief that the greater reliability of steel and mechanical control linkages should be taken advantage of when possible. The surfaces are cross balanced, with the elevator using aerodynamic compensation as well. Spring biased trim tabs are provided.

Control during landing is achieved with a steerable nosewheel which can turn 45 deg. to either side. It is operated by a steel linkage located in the column of the pilot's control wheel. When the aircraft is stopped the

Russian, Foreign Turboprop Transports Compared

General performance comparison of some major turboprop projects is shown here. The Russian An-70 is included to give a reference for judging the new aircraft. All figures are the manufacturers'.

Aircraft	Max Takeoff Weight	Cruise Vel. & Altitude	Power	Range & Payload	Maximum Payload	Passengers	Notes
An-70	117,435 lb.	375 kts mph @ 26,220 ft to 32,410 ft	14,000 shp 4,000 shp	1,240 mi. 4,000 mi. @ 16,000 ft	16,640 lb.	44	Flight Test
Boeing Stearman	127,447 lb.	424 kts @ 31,240 ft	10,000 shp 4,000 shp	1,240 mi. 4,000 mi. @ 16,000 ft	30,000 lb.	75-100	Flight Test
Vickers Viscount	45,000 lb.	334 kts @ 32,000 ft	4,000 shp	1,240 mi. 4,000 mi. @ 16,000 ft	12,200 lb.	40-60	Service
Vickers Vanguard	131,000 lb.	400 kts @ 32,000 ft	4,000 shp	1,240 mi. 4,000 mi. @ 16,000 ft	31,000 lb.	70-110	Production
Lockheed L-1049	105,000 lb.	400 kts @ 32,000 ft	4,000 shp	1,240 mi. 4,000 mi. @ 16,000 ft	31,000 lb.	60-80	Engineering Development
Boeing B-707	141,000 lb.	400 kts @ 32,000 ft	4,000 shp	1,240 mi. 4,000 mi. @ 16,000 ft	31,000 lb.	70	Service

adder and slusher can be located from the cockpit.

Aluminum anti-hydroplaning and electrical power to operate its equipment. The hydraulic system uses 3,000 psi pressure. It actuates and lowers the landing gear, brakes the wheels, turns the fuel shutoff valves, raises and lowers the windshield wiper. Emergency braking of the landing gear wheels is done by a gas cylinder. Reliability of the landing gear lowering system is insured because of the forward retracting main wheel. All of the gear will come down even the effect of its own weight and the air stream.

Electrical Power

Aluminum anti-hydroplaning and electrical power to operate its equipment. The hydraulic system uses 3,000 psi pressure. It actuates and lowers the landing gear, brakes the wheels, turns the fuel shutoff valves, raises and lowers the windshield wiper. Emergency braking of the landing gear wheels is done by a gas cylinder. Reliability of the landing gear lowering system is insured because of the forward retracting main wheel. All of the gear will come down even the effect of its own weight and the air stream.

Electricity generation includes air-cooled radial carburetors, solar glows (with vacuum suction and main circuit, according to Aeroflot).

Descent system is described as electronic. Its performance extends to the wing, empennage, the propeller and propeller blades. The engine air intake is located by hand or if no surface becomes obstructed the descent system is not self-sufficient. Light again makes the crew to monitor the descent system continuously.

Passenger cabins are described as

rooms. Height of the cabin along the center aisle is about 6.5 ft. Width at the center aisle is about 1.6 ft.

The fuselage windows are rectangular about 16 in. in diameter. There are 30 of these windows in the cabin, providing good lighting. Small air curtains are at each window. Walls below the windows are treated with laminated plastic which is an imitation of open tree trunks of wood. The sides and ceiling are covered with a tropical and earthy wood-grain material called "pewee". The covering is done in the form of tapestry panels. This supplies room work as the time and gives the cabin a smart appearance.

Continuous baggage racks run along the sides of the passenger cabin. They are also covered with "pewee". Each seat is equipped with a reading lamp, a combining table to blue and air and a lumbar to support the back.

Access to stowage children's car seats are provided on the forward walls of the passenger cabin.

Air Conditioning

The passenger cabins are also equipped with dome lights and heated by air conditioning. The conditioned air goes through vents at the base of the wall. Air pressure in the cabin is maintained at a steady level. Up to 16,000 ft the pressure in the cabin is the same as at ground level, and at 32,000 ft it corresponds to a pressure altitude of 7,570 ft.

For crew the cabin in the summer, which is heated by the heater, which feeds the conditioned air. This heater is driven by compressed air from

the engine. It is based on automatic and is about 1.5 ft. Width at the center aisle is about 1.6 ft.

Crew compartment is forward and surrounded by a crew of five. The main pilot's seat is behind the copilot's while the main operator is behind the copilot. A removable seat for the flight engineer is installed in the aisle between the pilots.

The cockpit canopy fits into the console of the fuselage rear and consists of flat, single aluminum glass panels, no coating to Aeroflot.

Insulating Vestibule

Just aft of the flight cabin compartment is an insulating vestibule which contains a 247 cu ft baggage hold, a heater and a wardrobe for the crew's clothes. This section also serves as an insulating vestibule which protects the passenger cabin from being struck the ground straps.

Buffer section is located to the rear of the forward passenger cabin and is at the sign of the turning propeller. It is equipped to move fuel and oil to the engine and main. It contains a refrigerator, heater, electric pump, carburetor and other housekeeping facilities.

Main passenger cabin is behind the buffer. It has 15 seats with five seats in each row. The seats are fastened in longitudinal rails with socket clamps. Space between seats now be decreased when it is necessary to increase capacity.

Seats were developed by the Russian Design Bureau. Before, back, and sides of the seats are filled with plastic and light foam plastic—"pewee"—and are covered with pink cloth

seats weigh 17.6 lb. On the back of each of these reclining seats is a pocket containing blanket and a small table.

A housekeeping section is located behind the main passenger cabin. It consists of a wardrobe and two lockers. The main passenger door is here.

The full section of the fuselage is built thus housekeeping area is incorporated. It houses the upper row 247 cu ft baggage compartment.

Two large baggage compartments located under the passenger cabin have a total volume of 983 cu ft.

SHORTLINES

►Trans World Airlines will provide deeper seat accommodations on all its transcontinental Lockheed L-1049 Constellation flights beginning Oct. 14. Each L-1049 will have 31 sleeper seats in the first-class compartment as an extra change. The seats are located in six rows as opposed to 35 seats in the second-class section. On Oct. 27, TWA plans to increase its domestic first-class capacity by 40% over that of the same period of last year and by 100% on its international routes. The airline's new schedule begins Oct. 27.

►Cock Air Lines plans to begin non-stop service between St. Louis and Miami via Detroit. In an Oct. 17 Aeroflot Civil Aeronautics Board decision authorizing the service, flight Cock Air Lines will reduce the flight time from St. Louis to Miami-Detroit to 70 minutes—a saving of about 45 minutes over present schedules which include two intermediate stops.

►International Civil Aviation Organization reports that the Latin nations will inaugurate the Central American Flight Information Region on Oct. 21. The six nations are Costa Rica, Nicaragua, Honduras, El Salvador, Guatemala, and British Honduras. Tegucigalpa, Honduras, will be the central office of the new region—a new block of air space from which all airplanes normally operated on civil aviation operations by the member of national borders have been removed. When the Central American region begins operations, all airplanes required by pilots flying through the region will be coordinated at the center in Tegucigalpa. The center also will pilot position reports and keep track of all aircraft flying in the region.

►Continental Air Lines will fly a new out of 90 West Coast bases, Detroit and intermediate landing in Dallas on Oct. 17. The route will be a direct flight from Los Angeles to Los Field.

AIRLINE OBSERVER

►Aeroline business this year will exceed the total of all airline traffic handled by the domestic carrier in 1945. Although the market rate is due to high degree of increased competition on major route segments, a large part of today's airline traffic is generated by the growing local service industry. As a result, airlines are competing directly with the smaller lines at such ventures as joint advertising and sales campaigns and personnel training programs.

►Japan Air Transport (JAT) has purchased two Douglas DC-6Bs for delivery in late 1955. Negotiations for the sale and arrangements for export license were handled under State Department auspices. Cost of the aircraft is approximately \$8.5 million for each aircraft not including spares.

►Norfolk Airlines and Eastern Air Lines last week were handling over 100 flights with their new Lockheed L-1049 Constellation aircraft. Norfolk Airlines flight because of a strike by the Air Line Pilots Association (ALP) Sept. 10. Norfolk Airlines operated two main sections on one section but before that there has been no scheduled service for additional service to accommodate Florida traffic which is currently low due to the shift from its pilot training program, a step it is planning to take in view of the additional equipment it is scheduled to receive during the balance of the year.

►Norfolk Airlines contends that 95% of its entire domestic profit is derived from its Chicago-Minneapolis route. The airline is the Civil Aeronautics Board that additional competition between Chicago, Minneapolis and the Twin Cities would seriously affect the economies of the airline. In the Great Lakes-Northeast Service Case, the airline seeks a Chicago-Florida route to offset the seasonal slump during the first quarter of the year on its northern transcontinental route.

►Southwest Airlines is the first airline in the U.S. to receive a Civil Aeronautics Administration certificate for commercial overhaul of turboprop engines. Southwest's license is based on its military contract overhaul work on the Allison J33 engine (AW Mar 13, p. 71).

►Civil Aeronautics Administration has issued the Constellation Department of Transport a \$5.5 million electronic computer for \$1.5 million of \$1 per seat. The computer was originally designed in a military tactical trainer, will be converted for use as a dynamic operational air traffic control system. Following conversion, it will be installed at the CAA Technical Development Center in Indianapolis.

►Confession of Local Airlines will enter its identity but all its administrative functions will be absorbed by the Air Transport Association. The new local airline will operate under the supervision of the association will use the Constellation as its primary aircraft to provide service on routes through the West. The airline will fly to Oakland, Fresno, Green, Merced and Elko. John F. Pickett, who resigned as CAA chairman when he was named to the Atomic Energy Commission is a member of the board. So other airlines which are based in the Southwest, the Association of Local and Territorial Airlines which is headed by Joseph Adams as executive director.

►International landing operations at Honolulu International Airport has been changed from a low altitude time saving between aircraft to a distance separation of three miles. CAA expects the new procedure will eradicate some of the problems of the airport from one international landing every four minutes to one landing a minute.

►Owen Empire Airlines plans to start its new all-weather flight route out of the U.S. in December with Lockheed L-1049 Constellation. The airline also will include two new flights, which will be the first around the world service offered by a single airline. The route will be a direct flight from Dallas to Tokyo on Oct. 17. The route will be a direct flight from Los Angeles to Los Field.



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Illustration of a TWA Jetstream aircraft in flight.

Airline Income & Expenses—July 1957

(in millions)

	Passenger Revenue	Mail Revenue	Express Revenue	Freight Revenue	Total Operating Revenue	Total Operating Expenses	Total Operating Income (Before Tax & Co.)
AMERICAN (TWA)							
American	23,717,799	226,721	190,280	1,326,129	26,228,929	24,773,971	1,454,958
Boeing	4,295,633	304,799	30,323	141,721	4,772,476	4,446,023	326,453
Capital	2,347,497	129,884	31,244	146,341	2,654,966	2,481,773	173,193
Continental	1,375,010	45,467	16,472	53,307	1,590,256	1,518,477	71,779
Delta	6,402,407	134,733	48,494	270,389	6,855,923	6,536,480	319,443
Eastern	16,275,471	220,734	470,947	1,129,167	18,096,319	16,773,226	1,323,093
Norfolk	2,331,170	14,537	16,553	129,167	2,491,327	2,396,476	94,851
Northwest	1,837,449	12,994	9,173	39,428	1,900,044	1,793,747	106,297
Northwest	4,411,440	138,743	344,647	1,129,167	5,024,000	4,676,475	347,525
Trans World	17,295,193	215,794	354,791	1,129,167	19,000,945	17,728,381	1,272,564
United	12,816,437	794,810	143,274	1,129,167	15,683,688	14,681,476	1,002,212
Western	5,444,513	84,163	39,197	74,428	5,642,299	5,196,177	446,122
INTERNATIONAL							
American	493,493	5,739	323	44,042	543,597	493,363	50,234
Boeing	703,444	25,389	34,193	44,042	807,068	711,470	95,598
Continental-N series	173,272	1,828	3,297	14,074	192,471	182,413	10,058
Delta	333,736	4,444	—	—	338,180	346,474	(8,294)
Eastern	2,708,293	31,117	29,793	—	2,769,203	2,593,229	175,974
Norfolk	1,894,434	444,183	291,194	—	2,630,711	2,398,399	232,312
Northwest	214,000	36,000	—	—	250,000	237,000	13,000
Trans World	11,447,000	224,000	100,000	—	12,771,000	11,708,000	1,063,000
United	7,034,000	188,000	—	—	7,222,000	6,981,000	241,000
Western	5,576,000	418,000	—	—	6,000,000	5,498,000	502,000
Passenger	1,543,000	40,000	—	—	1,583,000	1,547,000	36,000
Trans World	6,915,197	413,413	487,500	—	7,815,110	7,378,430	436,680
United	1,612,214	2,707	—	19,329	1,634,250	1,524,288	109,962
LOCAL SERVICE							
Allegiant	333,231	9,547	4,440	15,007	362,225	363,419	(1,194)
Boeing	149,449	2,145	1,143	4,107	156,844	151,446	5,398
Continental	134,710	3,819	5,643	5,643	149,815	148,914	901
Frontier	364,045	193,490	2,454	14,709	674,703	674,477	226
Delta	137,732	4,330	7,377	—	149,439	146,414	3,025
Eastern	737,343	179,349	13,344	—	930,036	873,779	56,257
Northwest	273,249	234,889	4,029	13,411	525,578	495,945	29,633
Northwest	479,775	9,344	3,167	9,333	501,619	481,214	20,405
Southwest	170,343	7,432	3,406	—	181,181	174,467	6,714
Southwest	384,349	8,349	2,936	4,319	400,053	374,304	25,749
Trans World	297,840	9,247	2,928	13,411	323,426	304,672	18,754
Western	1,612,214	4,167	1,316	4,319	1,622,816	1,597,903	24,913
REVENUE							
Passenger	126,811	2,741	—	46,445	175,997	164,821	11,176
Trans World	276,122	942	13,397	—	290,461	284,814	5,647
CARGO INCOME							
American	—	—	—	—	—	—	—
Boeing	—	—	—	—	—	—	—
Continental	—	—	—	—	—	—	—
Delta	—	—	—	—	—	—	—
Eastern	—	—	—	—	—	—	—
Norfolk	—	—	—	—	—	—	—
Northwest	—	—	—	—	—	—	—
Trans World	—	—	—	—	—	—	—
United	—	—	—	—	—	—	—
Western	—	—	—	—	—	—	—
HELICOPTER							
Chicago Helicopter	25,140	32,360	—	—	57,500	52,710	4,790
Los Angeles Airways	15,407	5,745	9,114	—	30,266	28,267	1,999
New York Airways	44,532	4,537	1,444	—	50,513	47,713	2,800
ALASKA							
Alaska Airlines	146,717	47,733	1,333	78,264	273,047	261,759	11,288
Alaska Coastal	31,384	8,079	—	11,120	50,583	47,717	2,866
Coastline	12,861	24,684	—	5,623	43,168	40,312	2,856
Delta	76,000	4,476	—	4,443	84,919	80,120	4,799
Pacific Northwest	740,133	42,723	102,731	—	885,587	874,719	10,868

*Not Available (Theater) Figures (System Figures) - Alaska
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board



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Solid Fuels Contend for Long Range

By J. S. Betz, Jr.

Thrust-to-weight ratio has moved into competitive position for solid fuels in long range missiles.

Until recently, it was thought that only liquid fuel rockets would be capable of providing requirements of great efficiency, high thrust and controllability. Simplicity, constant readiness, reliability, ease of handling and low cost characteristics which make solid rockets attractive to missile makers were less important.

First Major Test

Now, solid rockets are beginning to prove out in performance and efficiency comparable to liquid rockets.

First stage test of solid rockets as a large missile application was the Navy Polaris intermediate range ballistic missile. Navy dropped out of the Army Jupiter (IRV) program because of the unsuitability of storing and handling high energy liquid rocket fuel on shipboard. Polaris was started because the Navy believed light weight solid rockets now can meet the thrust requirements and control accuracy required for the 3,000 mi missile. Army also has under development a 2,000 mi solid fuel ballistic missile designated the Reg. B.

Two developments responsible for performance and efficiency of present day solid fuel rockets are:

- **Internal burning propellant charge.** Formed as the lat Propellant Laboratory of California Institute of Technology, the internal burning charge flows the gas in a very long, thin solid combustion chamber in place of the bars called porous solid previously required.
- **Electrostatic propellant charge.** Achieved by curing an elastomer with the fuel and oxidizer, the elastomer charge eliminated cracking in the charge which formerly gave solid rockets unpredictable performance and reduced structural weight by eliminating need for internal braces to support charge.

Relocating the burning surface of the propellant charge, made grain weight as light as possible. Forward the charge was either end burning or external burning. They were either ignited at the outside and burned forward to the front end of the motor or the burning took place between the casing and the charge along the whole length of the motor. The solid pressure shell was exposed to the combustion process and had to be thick and heavy to absorb a large quantity of heat. If it wasn't heavy on an internal burning charge, enough heat would be transmitted ahead of the burning surface to the front part of the case to explode the forward end of the propellant charge. On both the older types of charge there was danger of high temperatures weakening the case to the

Ballistic Role

point of failure during the long at the rocket.

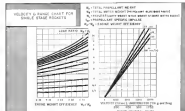
Internal burning charge is characterized by a longitudinal hole down the center of charge from nozzle to front end of the motor. Burning begins along the outer length of the hole and progresses outward to the chamber walls.

The walls are no longer subjected to combustion temperatures, is the fuel contained there. The case then can be designed merely to withstand combustion pressure. The solid strength of the motor is uniform, and a relatively thin, light wall suffices.

Elastomer Charge

Electrostatic propellant charge was achieved by mixing a polymeric rubber with the fuel and oxidizer. This prevented the charge from cracking and bound it to the case. Incredibly providing an elastic charge removed two serious objections to solid fuel rockets. One was cracking of the charge during ambient temperature changes and burning. These cracks frequently increased the burning surface and gave the rockets unpredictable if not explosive performance.

It also eliminated the need for internal braces to support the charge. This greatly reduced structural weight. Elastomer has now been developed to the point where it is used as a fuel



IMPORTANCE OF engine weight efficiency in solid fuels. For instance, if a 32,000 lb. boosted rocket is required to travel 1,240 mi, the total engine weight would have to be nearly 32 times the payload if the engine weight was 0.78. But if this efficiency was 0.83 the propellant system would only have to be six times heavier than the payload.

Liquid-Solid Comparison

Hypothetical solid fuel version of the V2 can be compared with the liquid fuel model which was used in service to show that modern solid propellant rockets are competitive in efficiency with liquid fuel rockets.

The V2 is used here because complete weight figures are not available on larger, more advanced ballistic missiles. Several errors are given in the text as to why this comparison is not intended to be completely realistic and could not strengthen anything but possibly indicate the efficiency possible with solid fuel rockets.

V2 DATA (LIQUID FUEL ENGINE)

All data is from Army manuals except the fuel tank weight. This was derived by considering 0.56 lb. of the total fuel tank system weight at 1,636 lb. to be structural structure not directly used in the tanks and their supporting structure.

ITEM	WEIGHT (LB.)
Fuel tank	1,080
Motor parts	2,061
Motor parts (total)	3,051
Fuel (total)	19,592
Motor (total, fuel plus motor parts)	22,643
Empty (dry-out fuel tank)	35,279
Total	57,922
Payload (empty wet motor parts)	5,174
M/M (total wet empty motor)	1.2
M/W (fuel weight/motor weight)	0.87
W/W (fuel motor weight/payload weight)	3.9
Thrust (includes some structural overhead)	31,000 lb.
Fuel consumption	375 lb./sec.
Propellant specific impulse (includes some structural overhead)	235 sec.

No consideration has been taken of the fuel necessary to drive the turbo pumps.

SOLID PROPellant VERSION

If some high charge oxidizer such as ammonium perchlorate and a hydrocarbon fuel are used, solid charges can equal the propellant specific impulse of the V2 (235 sec. with some structural overhead).

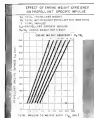
Propellant weight would then be 19,592 lb. to equal the total impulse of the V2. Despite the solid charge mentioned above about 100 lb./ft². Since the combustion chamber would only be about 90% full to allow for the internal burning cavity, the effective density would be 99 lb./ft³. Volume of the tank would then be 902 ft³. Assuming tank structure was approximately the same as the original V2 (3 ft. length of the tank is 3 ft. ft.).

Assuming a combustion pressure of 400 psi and 4150 steel for the structural, the wall thickness of the solid propellant motor can be calculated. (Working stress for the steel is taken as 120,000 psi.) If aluminum or titanium were used, the case would be even lighter.

Wall thickness for the structural portion is: $T = \frac{P \cdot R}{\sigma}$ where T is stress in lb./in.²

The 4150 steel weighs 0.29 lb./in.³. The weight of the case would then be about 565 lb. Assuming that the inside, insulation and inhibitor weigh 245 lb., the empty weight of the motor would be 1,050 lb. The solid propellant version of the V2 would thus have the following weight breakdown:

ITEM	LB.
Fuel (total)	19,592
Motor Parts	1,016
Motor (total)	20,608
Empty (dry-out fuel tank)	26,212
Total	56,820
Payload (empty motor parts)	5,174
M/M (total wet empty motor)	3.95
M/W (fuel weight/motor weight)	0.85
W/W (fuel motor weight/payload weight)	3.54



INTERRELATIONSHIP of I, W, W₀, and M/W. is given above. I/W₀ is a primary indicator of a propellant's worth. It shows the total impulse the engine can deliver for a given total engine weight.

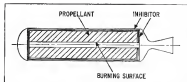


DIAGRAM shows internal burning, solid fuel rocket charge. Inhibitor serves as a bond between charge and nozzle case. It crushes burning, protects charge from combustion inspection when the charge does not serve as container.

and is chemically added to the normal solid fuel.

Cost and ease of producing solid fuel rockets not the impetus for the electrical charge. It is now possible to pour the composite propellant charge into the thin-walled combustion chamber where it later solidifies and is ready for use.

This composite charge is usually a mechanical mixture of two chemicals: ammonium perchlorate and an oxidizer.

Previous Design

Formerly, the loading or backing of solid fuel rockets was often dangerous business.

Thokol Chemical Corp. is credited with developing the polymer first used in an electric, and with the largest high performance solid propellant rocket powered by flight test. Dr. H. W. Rethel is a lecturer by the American

Rocket Society for his discussion of this work.

The rocket was the RV-A-10, a part of the Clement Horne missile program. It flew in the early 1950's and proved the feasibility of loading a large solid propellant motor with an internal-burning, electrical, case-based charge. Size of solid rockets has steadily grown and units in the neighborhood of 300,000 lb. thrust have been effectively fired. However, a knowledge of several factors concerning the motor and propellant is necessary to prove that such rockets can be used in a missile.

A rigidly solid evaluation of any two propellants can only be obtained by considering them in a complete weapon system and comparing to the best of system performance. Similar evaluations are possible by neglecting the relationship between rocket motor

and guidance system, missile structure, etc. Such studies are enough to indicate the general potential of a particular propellant.

Affects Velocity

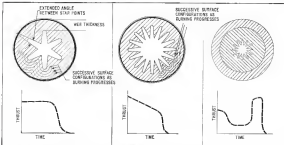
A most pertinent comparison for long range ballistic missiles is the effect of the motor on maximum velocity (neglecting atmospheric drag and gravity). Maximum velocity is a primary consideration for ballistic missiles because it (and the flight angle) determines the maximum range.

In fact, the maximum or maximum velocity depends directly on the propellant specific impulse and the length of the missile mass ratio. (Mass ratio is the mass of the missile at launch divided by its mass at burnout.)

Therefore, there are two ways to increase missile range: by increasing the propellant specific impulse and/or decreasing the empty weight of the missile. Cutting down on the empty weight is more effective in increasing range for the IRBM and ICBM than increasing the specific impulse. A more detailed look at the flight breakdown for very high velocity missiles studies this closely. One of the simplest and most rapid methods has been presented by J. W. Wiggins of Thokol Chemical Corp.

Weight Efficiency Defined

Very high velocity missiles have a low payload (structural weight, guidance, warhead, etc.) compared to total engine weight (nozzle, ports, tankage, propellant, etc.). The weight efficiency of the motor then becomes a primary consideration. The efficiency is defined



AREA OF BURNING surface governs the three produced by solid fuel rocket. Internal shape of propellant charge controls the area, and provides wide variety of thrust and acceleration programs. Configuration at right uses two types of propellants.

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in the ratio of the propellant weight to the weight of the motor inert parts plus propellant weight (W_p/W_m). The ideal weight efficiency is obtained when a ramjet starts the completely unburnable state of carrying only propellant with no combustion chamber, nozzle, etc.

The graph on page 50 shows that because velocity and range are more affected by engine weight efficiency than propellant specific impulse for high velocity, high range, turbo ramjets such as the TCRM and TRSM.

Despite the dearth of performance figures on all types of rocket motors, there is enough generally known information to compare roughly modern solid propellant rockets with liquid op-

erators. In order to get some figures to work with for a complete inside, it is necessary to go back to the V2 and compare a solid fuel version with the original.

Qualifying Factors

Many factors keep such a comparison from being in any way conclusive about solid and liquid fuel rockets in general.

Two of the most obvious:

- Liquid fuel rockets have been greatly improved since the V2 was designed.
- Solid rocket decreased their probable payloads as "solid" or ultimate design, in the strong is designed only to withstand combustion pressure. Although the internal burning charge has



Lockheed X-7 Makes 10th Flight

Lockheed X-7 target test missile with its rocket booster is shown in flight over Alameda, N. M. Normally one of these recoverable missiles has a life expectancy of three or four flights. This X-7, however, has completed 10 flights without damage. Recovery is accomplished with a parachute and nose spike. Each re-flight costs \$75,000 in the target test program, according to Lockheed.

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brought this shell close to saturation, other tests must undoubtedly be conducted.

Only purpose of the comparison is to provide a few numbers to generally orient the problem and to show that solid fuel rockets are in consideration, for use in very high velocity manner.

A table with the article gives the pertinent information on the V2 and the calculations and assumptions used to arrive at the corresponding data for the solid fuel version.

These calculations show that the weight efficiency of the original V2 was 87 and that the weight efficiency of the solid version could reach 95. It is hard to imagine a liquid fuel rocket with its present nozzles, tanks etc., approaching an engine weight efficiency of 95.

Reference to the graph on page 50 indicates that the solid version would go about 1,300 ft per sec faster at burn-out than the original V2. It is also clear from the curve that high weight efficiency becomes more critical as the mass ratio and W_0/W_b increase, which they must for very high velocity rockets.

Specific Impulse Rate

Specific impulse by itself does not lend an adequate impression as to range for high mass ratio rockets as it did for the scientific low velocity rockets of the past. In many cases high specific impulse requires lower engine weight specific at higher temperatures and pressures.

A quick way to be specific and give an impression is to relate them to the total impulse engine weight ratio (see graph page 51). This ratio is a generally good factor of merit in the propulsion field. It will equal the propellant specific impulse when the engine weight efficiency is 100%—an ideal situation when an engine is all propellant with no hardware combustion chamber, nozzle, etc.

Total impulse/engine weight ratio for the service V2 was 280 compared to 225 for the solid fuel version.

Another benefit of the solid version is the greater density of the fuel. The solid fuel rocket maintained low sea level thrust as long as the liquid one with its fuel tanks. Savings in length could have been used to put down forward ones and give a smaller, lower drag missile.

Weight Savings

Solid fuel rockets have another major advantage, in that they carry more payload into the missile structure and need to carry less. The high performance X-17 one-one test missile uses the type of design. The combustion chamber walls of its engines serve as the

outer skin as well as carrying structural loads and nozzles, etc. Weight savings such as the Block 30-40 are impossible for the same lifting masses to the case as well.

Careful design then allows essentially double use of structural material—to carry loads while containing the rocket motor combustion—and results in a reduction in missile empty weight.

Other major problems facing solid fuel rockets is ICBM and IRBM use in the very accurate programming and termination of thrust. Progress in this field is obscured by one of the tightest security orders in the country.

Basic problem though, is well known

Thrust and the flight vector must be aimed precisely, so that when the missile reaches an exact point in space at a prescribed velocity, the thrust will be extinguished.

Planning Important

The problem is completely analogous to a cannon firing a shell. The exact size of the shell is predictable because its velocity and angle of flight are known as it leaves the cannon. For the ballistic missile, the point at which the velocity stops or begins to occur, depends to the cannon nozzle. The velocity and angle of flight for an ICBM must be exactly as planned at burnout.

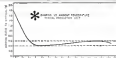
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if the metal is to stick its target.

A desirable factor is ideal to meet these conditions and that is what solid fuel designers probably are, striving for. However, it is now possible to program the thrust of solid fuel rockets over a wide range simply by altering the shape of the hole or holes in the internal burning charge.

Thrust depends on internal pressure which is controlled by the burning surface of the charge. Altering the geometry of the hole in the charge can hold the rate of the burning surface to close tolerances. (See page 52.)

This method of thrust and acceleration programming is fine for many missile applications, but is probably not accurate enough for the ICBM and JBM.

Since thrust depends on combustion pressure, some other means than charge geometry will have to be found to control this pressure.

One test, which has been published in test books, asks the designer to achieve a sudden and complex variation of thrust. Most projectiles require a rather high maximum combustion pressure (around 1000 atm). Any large and sudden increase in volume area when firing at altitude would stop combustion and increase thrust. This would mean to be large a mechanical design problem of providing a suitable opening to vent rapidly the combustion chamber to the atmosphere without producing some uncontrolled thrust.



Small Rocket Motor Delivers 40-lb. Thrust

One of the smallest solid propellant rocket motors is called PCL (pencil-like, experimental test). Similar to the spin rockets on third stage of Vanguard, it is now commercially available.

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The missile qualified six Navy teams in Regulus

tactics, injuries and maintenance. Repeated launches at 70,000 pounds thrust stretched her stamina. Flight and ground-run time on some components mounted above 1,000 hours. Operationally, however, the missile was sound when time came for her 16th, and final flight, a shipboard launching in a simulated nuclear attack.

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FIRST ELECTRA is completed structure at Lockheed Aircraft Corp's Burbank assembly plant with addition of empennage. Final is scheduled for first flight in January. Another of the fuselages, expected to be first in commercial service after delivery to Trans World Lines next fall, is now in fuselage mating dock.

Lockheed Completes Structural Assembly Of First Electra



OPENING of first Electra is shown in drawing (above). In earlier production stage, the fuselage's 707's wings are mated in 125-in. wide fuselage (left). Workmen inside the fuselage are building up wing structure, electrical and hydraulic equipment. Wings are integrally stiffened to minimize fuel leakage. This Electra is scheduled for delivery to Lockheed's engineering flight department in December. Another, now in the fuselage mating dock, will be delivered to Eastern Air Lines next fall and is expected to be the first Electra in commercial service. Lockheed has sold 341 Electras.



Library air travel at 50% lower is offered by Continental Airlines' Club Coach DC-7B's. They fly fast schedules between Chicago, Kansas City, Denver, and Los Angeles.



Says William A. Weeks, Assistant Director of Communications, Continental Airlines Inc.:

"Electronic equipment in Continental's Club Coach planes is extra-dependable because of G-E 5-Star Tubes!"

"Everything about our new Club Coach DC-7B's is impressive. This includes communications facilities, and radio and other navigation instruments. Their reliability helps us keep the fast, on-time schedules that are a part of Continental's Gold Carpet service.

"One reason—and a big one—for the dependable performance of our electronic equipment, is tubes such as the one I'm pointing to: 5-Star Tubes built by General Electric for air, military, and industrial sockets requiring highest tube reliability.

"These tubes cost us extremely low, and they outlast regular tubes by a wide margin. Continental's records prove both statements. Also—due to their trustworthiness—5-Star Tubes help keep our costs down. They cut our need to pull faulty electronic equipment and send it to our Denver shops for overhaul. This is

expensive in operating dollars as well as in flight delays.

"Continental looks on General Electric 5-Star Tubes as an important part of its effort to give the public the safest and best air travel."

Benefits from Continental Airlines' favorable experience: Your local G-E tube distributor stocks 5-Star high-reliability tubes. Phone him! Distributor Sales, Electronic Components Division, General Electric Company, Des Moines, Kentucky.

Progress Is Our Most Important Product
GENERAL ELECTRIC

Aircraft Operators Are Warned To Select Overhauls Carefully

Dallas—Joseph M. Chase, of the Flight Safety Foundation, advised air traffic operators here to "watch your over late and not your first consideration" in selecting suppliers and overhaul agents.

Speaking at the Southwest Aero-Port at Wilbur Wright Airport and Maintenance Forum here, Chase told the operators to make these people run a good overhaul, not a cheap one, to protect themselves from the danger of bogus parts.

Bogus Part Dangers

Citing the danger of using bogus parts, Chase advised operators to buy parts only from a prime manufacturer, an authorized dealer or a reputable maintenance agency. For critical work done in a repair station, he cautioned extreme care in selection.

Chase suggested that, in judging repair stations, operators look for a Civil Aeronautics Administration approved repair station certificate as a measure of facilities and personnel. Factory approvals and letters of commendation also were cited as handy indicators of reliable repair stations.

Continuations of the danger of aircraft parts by bogus parts is accent for those reasons, he said.

Bogus parts can endanger flight. Chase cited the example of a com-

and cargo transport that crashed and burned because of the use of bogus bogus parts in the elevator air controls.

• **Overhaul certificates** of an overhaul can be suspended or revoked if bogus parts are used in its report, maintenance or overhaul.

• **Bogus bogus parts** are much responsible to detect without extensive testing, making them difficult to eliminate through inspection. Some bogus parts can injure pilots and part wearers of pressure parts and are packaged like the original.

How Bogus Market Begins

Problem of bogus parts arose after World War II, according to Chase, when large numbers of aircraft engines were discarded rapidly and manufacturers quit making replacement parts for some of them.

As surplus engines and parts came into short supply, the bogus part problem was born.

Chase and the problem was aggravated by the fact that many new, genuine surplus parts lost their identity during the process of sale and shipment, making them unsuitable to CAA. This reduced the supply of usable parts and used prices.

Those repaired parts found their way into the market, according to



PUMP PRIMERS

by
Arthur A. Nichols

Low weight, high performance and increased adaptability to space and geometry of housing structure make G-E pumps ideal for gas turbine turbo and aircraft service.

Engineers concerned with drives, low-duty power sources, gas turbine and various industrial drives problems involving pressure lubrication have found G-E type pumps extremely useful in their attempts to hold weight down and achieve maximum compactness with high air flow reliability.

Several advantages of these pumps, for example, are their compact design, their ability to combine as many as five different types of impellers in a single pump housing, and their ability to operate in a wide range of temperatures. The G-E pump is a positive displacement type, delivering a predetermined amount of fluid in direct proportion to speed. It is a form of internal gear pump—very quiet and compact in basic design, (has only two moving parts). It is lightweight, valveless, provides exceptional performance and has low maintenance over a long service life. It is balanced and extremely quiet in operation.

Unlike conventional gear pumps the G-E pump uses only a single shaft. Back elements are substantially concentric to the shaft in a precise gear mesh. Back-lighting component without the complex structure necessary in other internal gear pumps. Porting and plumbing are completely trouble-free in location. Further, G-E elements can be stacked along a single shaft and mounted on a single A-B end to perform multiple pump functions: lube, service, bleed-off, etc. The back elements allow pump configuration to be adapted to the gas flow

Fig. 1 Integral Turbine Pump



Rotation Varies Jet Control

Close-up of Bell X-54 test shows one of the three compound air jets and for low speed flight control. Identified in appearance to the control jets used in Bell's Jet T-X, motion here is varied by rotating drive with bell crank valve inside fuselage opening.



Fig. 2 Adjustable Valve Pump

geometry. It can be "back-pumped" in a pump which frequently may be part of the same housing. (See Fig. 2).

Valveless design means absence of mechanical troubles and wear problems inherent in valve construction.

Technical information plus complete design engineering and precision manufacturing facilities are available to help you obtain the right pump to meet your specifications. Your inquiry is invited.

W. H. NICHOLS CO.
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Photo courtesy JAF

FLIGHT DELAYED!

An Exide battery could have prevented it

How Exide batteries protect you against sudden battery failure



The plane was on the ramp... waiting for clearance. Then the battery failed suddenly, with no warning... because corrosion had weakened the grid.

Now you can be protected from delay like this, at no extra cost. New Exide Aircraft Batteries are practically immune from grid failure. The secret lies in the corrosion resistant SilverGel® grid—as alloy designed especially for use in Exide battery grids. SilverGel grid water corrosion so well that they generally outlast the battery. So you enjoy new freedom from one possible source of delayed takeoff.

Three advantages plus the extra safety

protection available in these new batteries. And, at the same time, get the superior capacity and life potential resulting from the ultra fine active material and new, 25% more porous separator. Call your nearby Exide sales office or write Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 2, Pa.

N.E.S. Field

Exide®

Chase, and helped create a new market "whose integrity and responsibility are not requirements for doing business and where the only question asked here is to do with integrity."

Faced that traffic in genuine but unclassified parts, Chase said the market shifted to "unclassified" parts without benefit of engineering data and then to outright counterfeiting.

Chase pointed out that CAA provides for classification of parts through the holder of the type certificate and through approved parts manufacturers.

He said the problem in the system is that it was devised for "the guidance of honest people and not for the control of the dishonest." Power of CAA to suspend and revoke certificates and to control approvals doesn't worry dealers or buyers, he said.

Due contributions to the bogus parts traffic come from manufacturers' practices of identifying parts by drilling them with parts. When these marks were sold for scrap, bogus parts dealers found it easy to remove the proof and sell them. Now, most manufacturers are marking parts to cut down this source.

Chase observed that there are reports the airlines but not buyers can cooperate about scrap and reports. "They're not to be too hard to spend time examining worthless material," he said.

Navy Amends Lease For Engine Plant

Navy has amended lease for the Naval Industrial Reserve Aircraft Plant at Kansas City to permit Westinghouse to carry on subcontract work in all areas of the plant not required for engine and parts production for the Navy.

The plant is leased to Westinghouse for its aviation Gas Turbine Division and the company subleases parts of it to Bellini and to a consulting engineer firm.

Several provisions of the former lease are advantageous to the jet engine division from the standpoint of commercial work. W. W. Smith, Westinghouse vice-president and manager of the division, said.

"New pricing procedures have been established which will improve the division's competitive position appreciably," Smith said. "We also have enjoyed a good volume of subcontract work during the past year, the new agreement will enable the division to negotiate on a more competitive basis for commercial work from other divisions of Westinghouse as well as other companies."

The new agreement transfers administration of the lease from the Bureau of Aeronautics and Docks to the Bureau of Aeronautics.

AVIATION WEEK, October 7, 1957

NEW SERVO AMPLIFIERS DEVELOPED AT DAYSTROM INSTRUMENT

Typical items developed by Daystrom Instrument in conjunction with its systems work are these miniature servo components. Additionally, Daystrom offers custom designed units and servo sub-systems for data processing, automation systems, flow control systems, simulators and other applications.

3 WATT

48 transistor designed to operate 480 cycle motors with 50 volt motor input rated voltage. Overall Dimensions: 1.80 inches x 1.50 inches square. Length 2.25 inches. Weight 0.2 ounces. Input impedance 10K ohms. Gain 200. Power Supply 28 VDC. Amplifier package is plastic type with a Weather Type 344077-0 plug.



4 WATT

48 transistor designed to operate 480 cycle motor motors with 28 volt control voltage. Width 1.50 inches. Height 2.44 inches. Length 2.42 inches. Weight 0.25 ounces. Input impedance 20K ohms. Gain 1000. Power Supply 28 VDC.



Our servo engineers are ready to help you. Let us know your requirements.

DAYSTROM INSTRUMENT

Division of Dynalco Inc.
Radnor, Pennsylvania

AERONAUTICAL ENGINEERING



GM Seeks 'Fluidity' in \$60 Million Engine R&D Facility

By Robert H. Cushman

Indianapolis—Allison's new \$60 million jet engine development laboratory represents one of the largest self-financed jobs ever made by private industry in an attempt to secure a prime contract to develop business.

Allison Division, General Motors, now believes it has its first 500 hp turbojet part of the facilities needed to be competitive in gas turbine aircraft propulsion, but it has slowed down on outward the completion of the original 575 million program contracted by GM President Elwood Gortner early in

1951. The contract, has been to sustain the fluidity which Allison believes necessary to follow staff to the new aircraft and engine program of the Defense Department.

Turbo-Rocket Study

A step in this direction is the Aerojet-General Allison turbo-rocket engine study. Turbo-rockets are a form of ducted rocket which combine the low fuel consumption and thrust efficiency of a turbojet with the high altitude capabilities of a rocket.

Allison has also been awarded as the logical division for General Motors

to place any development work, which may result from GM's current proposal for a gas turbine propellant for the advanced version of the Maritime Administration's Avenger. Energy Commission studies powered aircraft ship (Public Law 508). The GM proposal comprises a closed-cycle turbojet turbine driving heat from a graphite-moderated, gas-cooled reactor.

GM of the 4,000-employee Plant 5 complex which is now more than half completed and in partial operation as new business for the other manufacturing plants of the Allison Division.

Allison is now manufacturing the 10,000 lb thrust PT1 turboprop for the Navy F1H-2N Corsair and the USAF Douglas B-66; the T56 turboprop used in the Lockheed C-130 Hercules; and some of the older J45s for the Lockheed T-33 trainers and the Martin TM-61A Meteors and the Chance Vought F4U Corsairs. Production of the 501, experimental version of the T56, for the Lockheed Electra engine is scheduled to begin.

Also in the road for new design which can be sold to the military services and commercial airlines when these engines and the T52 turboprop and 25,000 lb thrust J49 now in development are obsolete.

Plant 5 Rerun

Plant 5 is completely self-contained. It manufactures no product in the plant sense outside of the handful of development engines which are a by-product of an engine development program. It is a planned community in being able to accommodate itself into high performance hardware.

During engine development at Allison's new main design plant, parts of the engine designed in the engineering office (1) right as built in the model shop (2) and tested in the wind tunnel (3), compressor and turbine (4) and fuel control (5) test cells. Complete engines are tested in the static cells (6), the lowest flight test cells (7) and altitude simulation cell (8). Dynamometer cells (9) and large propeller cells (10) are for turboprop development.

For tests, fuel comes from tanks (A) and enters either from electrical compressors (B) and gas turbine compressors (C) while altitude conditions are provided by exhaust (D). Cooling towers (E) maintain water flow (F) to lower engine temperature. Compressor facilities on exhaust (see facing photo) with facilities in detail it will be seen that Allison has completed or started all but the altitude cell (8) and exhaust plant (D).



Outstanding features of Plant 5 are:

- Central air pumping units which can be combined to supply an impressive 500 lb/sec, 50 psi, air flow to the separate test facilities.
- Engine component laboratories in which the air supply is directed at selected portions of the engine to simulate actual operation in the engine.
- Model shops which are more elaborate and complete than those manufacturing shops.
- Large turboprop test cells capable of handling 15,000 hp turboprops using 31 lb thrust propellers and runs

static flight speeds up to Mach 1.2.

- Extensive, pleasant engineering and administration offices in the modern main office building.

Air Pumping Facilities

Of all these, the two air pumping plants stand out most in a variety, both because of their huge capacity and because they represent the heart of a modern development facility for an breathing engine.

Just completed, they are of two types. A low pressure gas turbine driven supply which feeds the compressor and

turbine development laboratories and a high pressure electrically driven supply for the combustion development facilities.

In the former, gas turbines with a total of 90,000 hp can supply 450 lb/sec of air flow. The 42,000 hp electrically driven supply is expected to supply 1.25 lb/sec of 285 psi.

The low pressure gas turbine supply is the more remarkable because Allison has used parts of its own engines rather than the usual industrial equipment. The main low pressure supply is made up of sixteen modified T56 compressors (only 11 of the 14 stages are used). Each modified compressor is driven by two complete T56 shaft turbines.

Electrical System

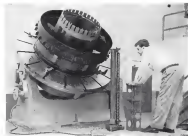
The electrical supply consists of conventional industrial equipment where synchronous motor drive centrifugal compressors.

Supporting the air supply are air exhausters made up from T56 combustion section turbine compressors during double-sided centrifugal gas pressure from a J45 engine. As it is removed from the compressor, it is added to simulate altitude conditions.

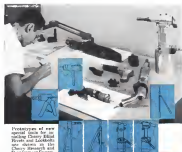
According to Allison, the advantages of using its own gas turbine components in this way are that signal is consistent with basic and air supply is available which produces stable air in five minutes after turbine light-off and can be shut down nearly by turning the fuel valve off. A steam-powered electrical generating plant in the other hand would have required 24 hours advance notice before a test and then,



ALLISON specialists such as this engineer design blade stresses study provide the "up per in depth" which leads up designers.



TURBOPROP being for J49 turboprop being checked for dimensional accuracy in model shop. Early visible in the main entrance where exhaust which has been by ground based high pressure compressor for up to Mach 2.5. Right in pass the turbine.



Prototypes of new special tools for machining Cherry Rivet and Lockbolts are shown in the Cherry Research and Development Department.

Special Tools

for building tomorrow's aircraft
being developed today by Cherry research

Higher speeds and operating temperatures of aircraft, missiles and rockets of the future demand fasteners with greater resistance to the stresses imposed upon them than ever before.

Installation of these high strength Cherry Rivets and Lockbolts* will require new special tools such as those now in the developmental stage in the Cherry Research and Development Department.

This activity—anticipating the needs of the aircraft industry and the military—is an old story with Cherry. For years, Cherry engineers and technicians have de-

veloped themselves to a single objective—the production of better aircraft fasteners and the tools for installing them.

Tools for solving specific problems—tools for efficient production fastening—all are developed and produced in the Cherry plant at Santa Ana which is devoted exclusively to the production of fastening equipment for the aircraft industry.

For information on the most efficient fastening methods for your operation, write Townsend Company, Cherry Rivet Division, P. O. Box 2183-N, Santa Ana, California.

*Several sizes that provide R 90,770; R 114,040; R 137,100; R 151,040; R 200,440 and R 274,300

CHERRY RIVET DIVISION

SANTA ANA, CALIFORNIA

Townsend Company

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if the nuts were shotted for use, means the remaining stores would have to be drawn down.

In comparison, the talent of Plant 5 is divided into six main groups:

- **Advanced design and development** which guides the investigation of new engines and in cooperation with the Allison sales department tries to introduce the industry in these new engines.
- **Turboprop department** which takes the project responsibility for new turboprop engines after they have been sold.
- **Power turbine group** which takes responsibility for new turbo-propellers.
- **Turbine components** which takes care of engine details.
- **Experimental facilities and testing** which arranges and operates the test facilities.
- **Production engineering** which has its executive engineer located in the Plant 5 office but is most concerned with production at the other manufacturing plants.

Use of Plant 5

To illustrate how Allison might use these facilities, the development cycle of a turboprop will be traced through Plant 5. The turboprop might be considered a full Mach 3.0 aircraft in Allison's 25,000 lb.-dry thrust 89 engine which has a weight flow of nearly 400 lb./sec. The new engine could be a replacement of the Allison 640 turboprop, a single used powerplant which lost the Wafford powerplant competition to General Electric Co.'s Gen Turbine Department, or it could be a result of the present joint Allison-Geared General study of turbo-rocket hybrids.

A new design commitment in the preliminary design section of Charles McDowell's 250-man Advanced Engine Design Group.

The 50-60 man preliminary design section led by research design division as McDowell's assistant, Jack B. Westcott, is continually studying the propulsion spectrum in close liaison with Allison sales engineers who alert the section to foreign markets. These engineers will take military propulsion requirements (which must likely will be stated in a request for bids in design competition) and draw upon their experience to consider first of all possible ways the job could be done and then which system should be selected.

The diagram of the selection would be speeded by programming the parameters on one of Allison's IBM digital computers and then running each type through. Allison is equipped with IBM 705, 704 and 650 computers. The resulting selection would be evaluated in an Allison proposal submitted in the selection design competition. Because the stakes are very high, pro-

posal \$70-150 million in business is involved, a great deal of intensive work goes into this phase.

These engineers do not have to create out of a vacuum. "The special virtue of a modern developmental complex like Plant 5 is that it provides the experimental readiness to conduct engineering in cooperation with GM's Technical Center in Detroit. Plant 5 provides a "community of knowledge" in which all specialized research workers—the metallurgy, aerodynamics and mechanical design are available as consultants to the preliminary designers. Allison calls this "support in depth."

Dynamic Operation

Basic ingredient of Plant 5's operation is that it provides the means to start and maintain the series of closed loops which are the essence of the modern engineering method.

For example, if the design group finds that one feature of its project cannot well make its mark, the proposal, the group can make this feature and put it through a development "loop."

Assuming the group is worried about the axial surge of a compressor blade, a representative blade can be sent to the model shop for fabrication, into a test specimen. The blade development would demand facility subjects that blade to simulated operating environment and records its performance. The test analysis group indicates the record of the test specimen's performance and feeds the digested information back to the design section, thus closing the information loop.

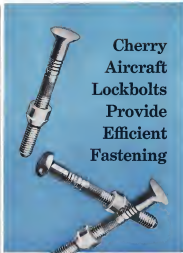
What the preliminary design section learns from the feedback after translates it to refine further its concepts and start another loop or goes if the confidence to gamble on its selection. According to Whipple, the preliminary design section might go as far as the direction as to test a complete engine component on turbine stage.

Design Process

In the overall development process of an engine these closed loops are called-toed in a continuous process which may be termed to a developing spiral which occurs in an ideal optimum configuration. The cross of modern research and development projects in the capacity and deftly work which a developmental organization can conduct these loops and increasingly close in on the best possible final product.

Byrd of GM's investment in Plant 5 would be the merest in speed with which Allison engineers can turn out successful new engines.

The advanced engine development group may work on the overall design selection and proposal presentation to the military from a few months to six-



Cherry Aircraft Lockbolts Provide Efficient Fastening

Cherry Aircraft Lockbolts* give you weight—give higher strength than rivets—save uniformity in hole size and hole—eliminate advantage of both—eliminate time in disassembly.

Cherry Aircraft Lockbolts are available from complete stocks in a wide range of diameters, grip lengths and head styles as either steel and aluminum alloy.

Cherry Aircraft Lockbolts are developed and produced to meet applications and requirements of the aircraft industry.

For data on Cherry Lockbolts, write for Bulletin VCC-111 to Townsend Company, Cherry Rivet Division, P. O. Box 2183-N, Santa Ana, Calif.

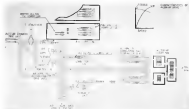
*Several sizes that provide R 90,770; R 114,040; R 137,100; R 151,040; R 200,440 and R 274,300

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SCHEMATIC of Plant 5 air supply shows how Allison has used parts "ported" from their older engines to supply the air for the development of new engines.

where to tip to a couple of years. Once an engine wins a military design competition and scores a development contract, the engine is taken from the advanced design section and given to the target design group where it becomes a formal project.

Project's Job

The engine project's job is to use all the facilities at it's command at Plant 5 to develop the basic design into a manufacturable item which last up to the performance parameters set by the advanced engine design group.

By breaking down the functions of the engine into component parts the whole Plant 5 can be phased into and various specialists in the overall development program.

The development of a light weight efficient compressor is perhaps the most important portion of a turbojet engine program. At Allison, the hardware development of the compressor might start with epoxy plastic road travel models of blades being milled in the new Plant 5 plastic tooling shop. Allison says that the plastic shop can produce test blades accurate to .001 in. of contour and then can make, say, the method to provide duplicate blades for cascade testing.

The first facilities used in the compressor development program would be the small 10 lb./sec. cold flow wind tunnel in which these plastic blades skimp up to 5 in. in length would be tested. After individual blade analysis has been completed, test of

Aeroquip Engineering Notes



A.A. KUNTZ, JR.

The advancement of the spiral process is now an absolute for high pressure hose of Teflon. Recently there is a revolution in the type of construction and all try to determine why we did it.

The most widely used measuring site for spiral high pressure hose is the lap joint. In this type of construction, the hose line is subjected to hydraulic liquid pressure varying from 5 pressure to 3000 psi, with a surge peak pressure which reaches 4500 psi. The pressure surge drops in three below.



A hose that is subjected to pressure if it will with stand 100,000 cycles or equivalent of the present cycle, and in the case of hose of Teflon, the hose is the hose and the spiral is surrounded by it must be tested at 400° F.

We began this development by testing and testing hose using conventional hose with limited reinforcement around the hose tube of Teflon. In the 4 case, hose which proved to be adequate reinforcement to the lap joint test, with four months more testing.

In the 4 case, we tested some construction of two-way limited hose of Teflon. We applied both 300 and 350 cycles test when it was tested at 400° F. We also explained the use of carbon steel wire for the first spiral using carbon steel wire. Twelve separate spiral tests involving thousands of cycles were necessary to establish all characteristics in every case or more complete test before completing the 100,000 cycles of testing. Our experience with the 4 case provided test with the 4 case.

The failure always begins with the hose test hose, individual wire break at the specimen which are found when wire are first brought over and then under other wire is breaking. As soon as a sufficient number of the individual wire break, the hose breaks during the test.

The solution to this problem was to eliminate the concept of testing by subjecting the hose spiral wire wraps for the steel test. The required wire reinforcement and technique but we were unable to test successfully.

We have now finished the spiral high pressure hose testable in the 4 and 5 cases. The complete testing hose included both positive steel wire and carbon steel wire for the spiral wrap and both when tested the 100,000 cycles every time.

When the project has increased now that it is now possible to build a limited hose line 4 and longer which will withstand the complete test every time the hose could be subjected to the test.

In our tests of the 4 case we obtained test successfully of limited hose, but when these were subjected the complete test, on our test pattern by one test alone.

The spiral construction provides the best high pressure hose available today. It can be used in the case of hose used in equivalent hose tested hose, and complete success usually in repeated and tests.

Continued on page 10
NOT REPRODUCED
AEROQUIP CORPORATION

SPIRAL WRAP adds lasting strength

Stainless steel wire is closely wrapped of a circular angle to form a smooth reinforcement layer. This prevents traveling of the tube, eliminates wire stress and corrosion common in limited pressure hose and provides additional strength and flexibility. Entire cover is stainless steel wire braided. Tube of Teflon is dependent Aeroquip test.



Specify Aeroquip 677 Hose of TEFLON® and Reusable "super gem" Fittings for 3000 psi. Systems

GET ALL THESE IMPORTANT ADVANTAGES:



Indeed, this is the only wire shown here. Reusable "super gem" fittings provide dependability at all pressures (15 is tested in metal hose only) to 400 psi and tested by the hose of Teflon control, but not supported, between the rigid and elastic. Compression of wire reinforcement (40 elastic positive grip and testing procedure is given fitting wire-wire).

Effect hose wire for high pressure systems, reusable "super gem" fittings, Aeroquip.

How strong the hose and how the hose is the hose construction performed by Aeroquip... multiple spiral wrap reinforcement their results improve fatigue and prolong the life of the hose line. Reusable "super gem" fittings that are used fittings are often the most expensive part of a hose line, will work saving when engineering or production changes call for final line alterations. With "super gem" fittings you save dollars, not pennies. The fittings, hose line assembly can be disassembled in quick and easy, using ordinary bench tools.

High performance, high temperature hose lines of Teflon especially designed for 3000 psi. water systems for the testing purposes of hose lines for aircraft applications. Ask the dealer before for complete information.

Aeroquip Corporation, Jackson, Michigan
Western Division, Burbank, California
Aeroquip (Canada) Ltd., Toronto 12, Ontario

Aeroquip



TURBINE component facility is typical of test rigs which perfect some parts of the engine in solution. Air coming in from left is directed at the turbine, (center) and exhausts through a diffusing section. Force developed by the test turbine is absorbed and recorded in the dynamometer (right).



ENGINEERS & TECHNICIANS
The ideal working conditions with a dynamic, sensitive equipment and service in-Chief Engineer, 3000 Brookridge, Atlanta, GA.



seeing a hot one...on Hallamore captive TV

The hot test, and perfectly too rare-splitting, for clear, on-the-spot observation by human beings—when high thrust propulsion units are fired up for test, Hallamore closed-circuit television takes over the job. Throughout industry, similar Hallamore systems are finding application, wherever the requirement is for remote observation or for live transmission of visual information. Hallamore Electronics designs, develops and manufactures remote ground support and on-flight instrumentation systems, magnetic products, electronic components and audio visual communications systems. Current activity includes contracts for the United States armed forces and prime contractors of the aircraft and aerospace industries.

HALLAMORE



ELECTRONICS COMPANY

a division of the SIEGLER CORPORATION

Miles would be tested in cascade.

Development grows progressively into tests of complete engine stages. In this, Allison compressor and turbine axial facility would be used. A 15,000 rpm, 3,500 hp motor at a 100 lb/sec airflow is used in the testing compressor and turbine wind tunnel. (Until such time as this facility is completed GM's console wind tunnel at Detroit would be utilized.)

The ultimate in compressor testing is the compressor-compressor laboratory, in which a complete compressor assembly is driven by two modified Allison J71 burner-turbine combinations, with air for both test and driving turbines supplied by the plant air supply.

J71 Turbines

The two J71 turbines supply 30,000-40,000 hp, to drive the compressor for a jet or larger engine. They are directly indicator flow, each of the output of a freeturbine "locked up" in the compressor-turbine assembly will to complete the operating cycle.

For simulation of high speed flights, 500 lb/sec airflow can be pumped from the plant supply and measured into the test compressor. The inlet air can also be delivered at various temperatures and pressures to simulate exactly the full range of altitude effects. By adjusting temperatures and pressures to alter the "corrected airflow" the 400 lb/sec J71 compressor was developed in these facilities.

The turbine is likewise developed through individual blading cascade, individual stages and up to complete full scale operating level.

But instead of being driven by a shaft, it is driven by the plant air supply and the resultant shaft output absorbed by a 25,000 hp dynamometer. It should be noted that since cold air is necessary the turbine in the simulation, it will not produce enough horsepower to reach that needed to drive the compressor component in its test.

Compressor Test

Unlike the compressor and turbine component test facilities, the Power 6 compressor facilities are incapable of testing the full compressor of a large engine. Instead either individual compressor stage or a complete engine in the 500 or pre-packaged slices of a full axial compressor, which would consist of 10 to 12 of the complete compressor, are tested.

The maximum conditions which can be simulated at the compressor entrance are 120 lb/sec airflow at 1,000F and 200 psi. The latter figure would indicate that Allison complete compressor stages up to nearly 100 lb/sec flow to the compressor inlet up to 8,000 lb/sec at up to 600 psi.

The test values which automatic test measures in the separate facilities are automatically collected and send into Control Data Recording's bank at IBM digital computers which are programmed so that they rapidly collect the record bits of information, put them in sequence, automatically solve these equations, and present the results to the design engineers in as useful a form as possible. The more directly a test result can tell the engineer which way to alter the design process, the better performance, the better.

The test system laboratory is a 15,000 sq ft facility (80% complete) which can safely test had controls for

Macch 10 aircraft in 500F, 50,000 ft environment.

In the early stages of an engine's development, the component-makers report in the engine fuel control design series to the Chrysler control companies to rough out the characteristics for the individual components in the fuel control.

Component Plotting

Further along, the actual component will be plotted, substituted into the engine test set up. First components, then the complete fuel system will be installed in the temperature and altitude tanks to see if the dy-

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Weston's Pneumatic Actuator Control Valve Package Combines 6 Components in a Single 6.4 lb. Unit!

While controlling the pneumatic actuator, this weight and space saving valve also provides for anodizing pressure at the opposite end of the stroke. It affords extremely fast operation (maximum at 64 seconds) and low leakage (10 cubic inches per hour). The selector valve is non-interflow and detented to maintain position. If you have a weight and space problem, let Weston's team of specialized package engineers solve your specific application.

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some performance detriments. Flat 5 tests themselves less turbulent benches which take flows up to 150 gpm. and 1,500 psig.

Complete Engine Test

After perhaps two years of gaudy may-day and component work and developing the basic portions of the full scale component work, the first entire engine is built by the Flat 5 model shop. Though all design and development may not yet be associated from the component tests, the first complete engine is brought along so that leading line designs and the model shop workpieces can experience three cycles with the mechanical and stress testing aspects of the engine. Actually, without an ongoing development program it would be impossible to squeeze all of the skills of Flat 5 into a five-year engine development program.

First the emphasis is on smooth mechanical operation. It is even felt that the engine will be pre-assembled, built (without blading for compressor and turbine) and installed to check clearances and lubrication.

Flat 5 has a row of 5 static test cells to build operating experience with new engines. New engines often take 2,000 or more hours of static cell testing before they are debugged sufficiently to pass the official USAF 50 hour flight qualification test.

Flat 5's storehouse of knowledge

continues all through the development program. As the static test shows up defects (like engines are continually torn down and examined after the usual breakdowns are alerted in the various operational benches of Flat 5. For example if a combustion liner keeps developing cracks after so many hours of running, the combustion development laboratory may drop some of its work and concentrate in a redesign which will permit the engine to pass the 50 hour test.

Once the 50 hour test milestone has been passed, the emphasis is switched from endurance to performance. The more subtle problems such as blade vibrations, uneven temperature distribution across the turbine nozzles, can permit scope on very rapid acceleration, low leakage port work and a host of others are opened out over the breadth of the department. One by one these are "locked" perhaps by going back to component tests where the problem can again be isolated in a situation.

Flight Simulation

Though Albany has a flight test bench at nearby West Coast Municipal Airport, the chances are that unless the engine for which the new engine has been scheduled is ready at USAF's Edwards AFB flight test center, there will be no flying test bed capable of taking the new engine up to its full performance.



Army Gets First Cessna YH-41

First of its production quantity of Cessna YH-41, Sonoma four-place helicopter leaves Whittier, Calif., for Edwards AFB, Calif., where it will be sent to U.S. Army Ft. Rucker, Ala., installation for trials by the Vietnam Battle Transportation Group, and Midwestern Command and Aviation School. Powered by a 270 hp Continental TS6015SA, Sonoma gross 1,800 lb., has a useful load of 910 lb. Cruise speed is over 100 mph., endurance is 5-6 hr.

Air Force Infrared measuring program chooses Barnes Instruments



Personnel of 3d AFG, conducting tests from the F-4 Phantom II, for the IR test.

The majority of participating groups in the Air Force's infrared measuring study on infrared calibration of background and targets selected Barnes infrared measuring equipment.

This equipment included Infratec and Radiometer, Optotherm® Far Infrared Cameras and low and high temperature Infrared Reflectance Sources. Barnes Engineering is the only commercial source for completely integrated calibration, testing and measuring instruments of this kind.

The standard line of ground field and laboratory infrared ranges were offered by Barnes, including:

- Infrared Radiance Measuring Equipment
- Infrared Radiation Sources
- Temperature Infrared Detectors
- Building Blocks for Infrared Systems

Advances in radiation detection and remote measurement measurement are much to development that augmented with the Infrared Division of Barnes Engineering. They are equipped and staffed to develop your infrared system.

If you are checking or using infrared, write for complete information on the standard line of Barnes Optotherm infrared radiometers, sources, detectors and components.



BARNES ENGINEERING COMPANY
Bloomfield, Connecticut

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describes developments in infrared
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Westinghouse proves performance of new J54 Turbojet

The J54 . . . designed by Westinghouse as an investment in the defense of America . . . has passed a major developmental milestone.


Less than 30 months after design conception, the J54-WE-2 has:

- performed successfully . . . a 150 hour endurance test
- performed successfully . . . flight tests at altitudes limited only by the service ceiling of the test bed
- performed successfully . . . simulated flights, higher than any reached by operational turbojet aircraft, in an altitude chamber at the U. S. Naval Air Turbine Test Center

This medium thrust class, lightweight, single-speed turbojet has been designed for economical manufacture and operation. Continuing studies of advanced J54 configurations give promise of further satisfactory performance in many applications.

Successful performance in this Westinghouse-financed J54 program typifies Aviation Gas Turbine Division capability. For J54 application data in convenient DAPE form, or general information on Westinghouse expertise, call your Westinghouse Defense Products salesman or write: Westinghouse Electric Corporation, Aviation Gas Turbine Division, P.O. Box 285, Kansas City, Missouri. 2-6401

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This professionally new algebraic plane sailing "Dyspeptical" is used by the author, and other highly made available writing in the scientific, statistical or statistical industries. The various arguments and even with which writing can be compared will reduce the normal ideas upon the new borrowing and able borrowing by as much as 10%. With Dyspeptical a writer's book can be applied as a model and a more alternative than an experience author writing, as used in a substitute for taking and using, as well as a more interesting etc. When Dyspeptical is used, the need for doing commercial writing is eliminated.

Expendable is flexible, provides nonvolatile to work points, and offers ease of application. Expendable is available in many sizes including blank and eleven phrasal and can be obtained in quantities and lengths from 20 to 100 ft. When placed it will withstand a burst strength test of 50 lbs per inch and is available from 1/2" to 4" (3/8" additional strength available 4' long).

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over. Even if there were it has been found that it is less water expenditure to simulate the high performance athletic conditions, if possible, on the ground.

Altman had originally planned for both altitude and speed simulation test cells to be completed by 1999. However, because of the present lack of government interest in large air-breathing propulsion systems, Altman has decided to slow down on the work on its flight ram cell and to hold the altitude cell (which the source pegged at \$15 million) in abeyance.

Ready for March 3

Even so, since Plant 5 now has the necessary air supply, Altman could have both these facilities completed by the time any Nock 3-0 organic cancer alarm.

The largest high speed flight simulation facility now 30% complete will run 900 lb/sec air into the engine through a choked nozzle to simulate Mach 20.50 speeds. The engine inlet pressure under these conditions will be between 10-50 psi, and the temperature will go up to 600F. Thrust measuring capacity is planned to be 50,000 lb with fuel flows 50,000 and 100,000 lb/hr to the engine and afterburner respectively. Seven hundred and more data channels will lead to Control Data Records.

The altitude simulation facility, by far the most ambitious feature of the original plan, including the airway plan, was to have been of sufficient size to test a 295 ft/sec. airflow regime

Suppressor Details

Curved silicon inside developed for the Bell-Royce Arm 29 engines on the Cassini 3 consist of six small triangular hinges inside the type. These are distributed to take the place of the popping inside at the end of the type. Cocking in from the line stream is popped through external holes by the spring action of the silicon (AW Sept 23, p. 32). Silencers were effective in evaluation.

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pay for stays in the paper." That's why *Albano* is the best seller among all trading papers.

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Or use a plain sheet of paper if someone's already snipped the blank below. Give your name, address, and firm name, twenty-five words or less telling why you prefer Albemarle tracing paper, and mail to K&E Albemarle Contest, Box 160, New York 66, N. Y. before midnight, November 30, 1957.



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up to 66,000 ft at Mach 3.0. The fact that despite its aggressive magnitude it could go on further except of course on small engine units illustrates why as private contractors can afford to duplicate the complete flight envelope consisting facilities applied by NASA's Unmanned Plane Mach 3.0 to 3.5 (and a word here) or the uncompleted facilities of USAF's Arnold Engineering Development Center, Tullahoma, Tenn.

These government facilities would be used to complete the flight envelope at the cost of the engine development program (AWE Aug 5, 1976, p. 202).

Complete Run

The chosen of the ground program would be a run of the complete inlet-engine-cumulator propulsion package in conjunction with the jet engine manufacturer in Tullahoma's gigantic 16 ft square test section supercritical propulsion windtunnel. In this test, the propulsion system could be flown up to full Mach 3.0 and up to 100,000 ft altitude with full simulation and even further with partial simulation of flow conditions. In today engine contracts such runs may be used to verify the contractor's performance of his contractual obligation, and provision of similar in plant simulation facilities are important in helping the contractor produce a high performance propulsion system.



Chinese Troops Use Helicopters

Evidence of increasing airborne capability of Chinese Communist forces is contained in these photographs of troops and weapon loadings from Hind helicopter during recent runs. Your contribution to China message in support. Honolulu an USSR-built.



ATLAS Precisioneers

"HUSH-HUSH" ASSEMBLIES FOR THE FALCON



NO HUSH-HUSH "assemblies" for every business with The Falcon on the line. This newest model missile is being produced for the U. S. Air Force by Hughes Aircraft Company.

Some of the "secrets" of the bird of prey are ATLAS Precisioneers and classified "confidential." But there's no secret as to how ATLAS can help you develop parts and assemblies from pilot stage to production efficiency for rider... sensor systems... computers... corrections... all types of electro-mechanical devices. Just bring your designs to ATLAS. At your disposal as a job team are our men, equipment, techniques, facilities available for prototype, pilot run, and/or volume production.

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Our computer laboratory is equipped with the UNIVAC System, the "Colossus" of computers. It now boasts 1300 sq. ft., it is leased at a cost of \$40,000 per month. ORO's performance is immediate compared to those with resources and capabilities to develop their own facilities. For example, staff members are taught to "program" their own control for the Univac computer so that they can use its services at any time they so desire.

ORO during its years are recognized with those of today and offer great research opportunities. Positions are based solely on merit. The proper background is a must. The proper background is a must of those given by many companies.

The civilian and military features which attract recruits to Washington, D. C. are not a short drive from the pleasant Chevy Chase suburb in which ORO is located. Attractive homes and apartments are within walking distance and readily available in all price ranges. Schools are excellent.

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Hiller Assembles VTOL Transport

One of two 4300 cph, Allison T38-A40 turboprop engines for Hiller X-15 VTOL transport is shown before installation in modified Chase transport. A model of the USAF sponsored wing VTOL, two completed aircraft flight tests. Photo above shows how completed X-15 will look. Transport will have full-size landing gear, wings are fixed with small wheels on long struts to stabilize X-15 during landing and takeoff, counter-rotating propellers are fitted in tail to provide control during homing and transition flight stages.



Simplify ordering and assure uniformly high quality of performance, with the advantage of Norden-Ketay's nationwide field engineering service. The following 6 pages describe modular units in Norden-Ketay's family of control components.

You may use the coupon below to request literature on any unit.

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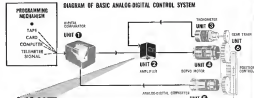
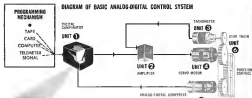
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UNIT 1

DIGITAL COMPARATOR



New design permits true digital control with conventional servo motors and amplifiers

Norden-Ketay has packaged a new Digital Comparator that works with standard servo units to give servo systems the accuracy and reliability of digital control techniques. Used with N-K 13-bit and 31-bit analog digital converters, the Digital Comparator supplies circuitry and provides absolute reference by eliminating pulse counting.

In operation, a heavy feedback signal indicating position of the controlled device is fed to the comparator by the ADC. This signal is compared with a pre-set binary signal, usually from tape, card, computer, or other command source. Lack of coincidence between the programmed and actual positions produces an error-modulated AC output. This signal indicates the magnitude and direction of the positional error and activates the servo motor to drive the device to coincidence.

100% transistorized, printed circuit design eliminates tubes and relays, making possible a rugged package for severe environments, with great flexibility in range and configuration. By effectively bridging the gap between digital programming and analog control, the Digital Comparator opens up a wealth of possibilities for simplified solutions to difficult control problems.

Send coupon on page 48 for Bulletin #N-K-18 containing data on Digital Comparators. Norden-Ketay Corporation, Western Division, 13270 Crenshaw Boulevard, Gardena, California.

GENERAL SPECIFICATIONS

Weight: 18 lbs. Net weight: 16.5 lbs. Dimensions: 11" x 11" x 11" (H x W x D)
 Input: 13-bit and 31-bit. Output: digital: 40 cps to 1000 cps

CONTROL COMPONENTS

UNIT 2

SERVO AMPLIFIERS



Wide choice of Norden-Ketay amplifiers permits exact matching of units with servo motors

Servo amplifiers are available to drive the complete line of Norden-Ketay servo motors, varying from size 1 (1.15 watts, control phase) to size 33 (16 watts, control phase). High gain, low response time, and compact size are outstanding characteristics, resulting from the unique design features introduced by Norden-Ketay.

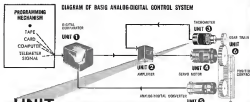
The standard selection includes amplifiers of electronic, magnetic, and transistor types. Transistorized models, combined with N-K precision resistors, can achieve small system accuracy better than 0.07% from -35° to $+110^{\circ}\text{C}$.

To broaden the system designer's field of operation, modifications of standard units are available to provide satisfactory operation over a wide range of ambient temperatures (-55°C to $+125^{\circ}\text{C}$), and under adverse environmental conditions.

Where standard units do not meet your particular requirements, Norden-Ketay welcomes requests for the design of special amplifiers.

For Bulletin #182 with full information on amplifiers, send coupon on page 47. Norden-Ketay Corporation, Precision Components Division, Commack, Long Island, N.Y.

CONTROL COMPONENTS



3

TACHOMETERS



Tachometers present the designer with a new range of possibilities for control systems

Norden-Ketay's firm tachometers designed for accurate speed measurements and for use in velocity servo systems and stabilizing systems. Units are pre-engineered to insure inherent stable operating characteristics.

Norden-Ketay's integrating tachometers assure extremely accurate computations over a wide range of control temperatures.

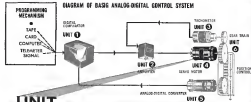
The voltage output is pre-tuned to $\pm 0.2\%$, saving the systems engineer considerable time and money when installing a tachometer into a new system or replacing tachometers.

Linearity of $\pm 0.02\%$ of the voltage output at 1600 RPM from 0 to 4000 RPM. Temperature compensation holds output predicted to $\pm 0.5\%$ from -59° to $+48^{\circ}\text{C}$. This compensation is done with a pre-

vious network which increases reliability, eliminates ratio noise and phase shift problems that occur with a thermistor-controlled heater unit. Extremely high ratio of signal to in-phase fundamental rail voltage of over 800 to 1. For extremely precise integration, a specially amplified controlled heater holds output predicted to $\pm 0.02\%$ over a temperature range of -59° to $+48^{\circ}\text{C}$.

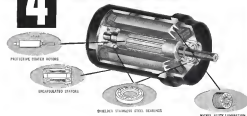
For damping tachometer purposes Norden-Ketay has improved the basic Mark 12 and Mark 16 types by providing external features that insure greater reliability, stability, and lower rail voltage.

Send coupon on page 67 for Bulletin #423 containing data on wide selection of Tachometers, Nucleic-Ketay Corporation, Precision Components Division, Commack, Long Island, N.Y.



4

SERVO MOTORS



High torque-to-inertia ratios of Norden-Ketay servo motors give fast, precise response

The ability to correct error rapidly and precisely is almost instantaneous. Nucleic-Ketay servo for control systems where a combination of high torque and reliability are required. High acceleration, smooth performance at low-start conditions, and operation at low control voltages assure fast, dynamic servo response.

A complete range of sizes and types enables the designer to fill his requirements in size, characteristics, and special considerations features with standard Norden-Ketay units. Dimensions of $3.50"$ (type 15) to $1.250"$ (type 23) are available. Standard 400 cycle units have shaft speeds ranging from 0.25 to 7.0 inch ounces, while 60 cycle units are rated from 1.43 to 7.6 inch ounces.

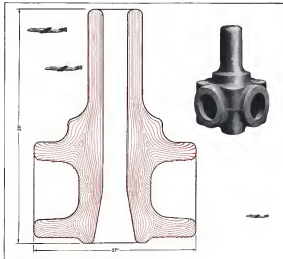
Special design features in standard models provide

a variety of shaft extensions and control voltages. Control phases can be driven directly from vacuum tube plates or from transistors. Units can be supplied with low input power requirements for the control phase, to ensure the performance of a relatively large motor.

Nucleic-Ketay servos can be combined with gear trains or tachometers to produce general servomechanisms or geared servomechanisms.

The availability of these design variations in a complete size range of standard motors simplifies system design, reduces component costs, and speeds delivery.

Send coupon on page 67 for Bulletin #423 containing data on servo motors. Nucleic-Ketay Corporation, Precision Components Division, Commack, Long Island, N.Y.



THE SPLIT-DIE FORGING SOLUTION FOR TURBOPROP TORSION

This big Turboprop propeller hub for Curtiss Wright was turning up a stem in design circles. Specifications called for 2600 lbs. of A1-S1 4355 modified aircraft quality steel to be forged and heat treated to high strength levels, all of which is not unusual except for one thing. The tremendous power transmitted through the neck section of the hub subjected this area to unusual stresses. Grain structure was a prime consideration. This presented a problem because conventional forging methods could not produce the desired grain flow pattern.

The Comar split-die forging process solved the problem for

Curtiss-Wright in a single pass through Comar's largest largest airframe press, a glowing biller was placed from six different directions and sheared into the near final shape shown above. Grain structures were exactly right. As an added benefit, far less machining time was required to complete the hub.

This hub is a striking example of Comar's ability to economically solve design problems through the use of a new forging concept.



Shapes and sizes formerly considered impossible to forge in closed dies have become routine procedures with this revolutionary technique. If you have a component problem that forces you to accept castings where forging quality is desired, or if conventional forging processes fail to give you the metallurgical quality or economy that you require, write, call or come by...



Flight Line Test Set

Set for flight line checking of aircraft pressure instruments and includes various two types of pressure gauges and generates selected pilot and status pressure for testing altimeters, Machmeters, airspeed indicators and true airspeed computers.

Self-contained equipment weighs 85 lb. and can be operated by untrained personnel. Range is from 100 to 1,000 ft. and -1,000 ft. to 50,000 ft. Accuracy is said to be $\pm 1\%$ accuracy, $\pm 1\%$ or ± 1.5 ft. of altitude.

Nucleon-Katy Corp., Commerce Rd., Standard, Ohio

Missile Sequencer

Motor-driven sequencer switching six use operation designed for missile launch operation, firing, starting of equipment and sequencing of external instrumentation calibration signals. Unit has been used extensively in two sounding rocket programs according to the manufacturer.

System consists of a motor-driven 28 v. d.c. constant speed motor attached to a planetary gear box which rotates a wiper arm across equally spaced contact wheels in a parallel circuit. It will work during and after acceleration loads exceeding 100G and at altitudes of more than 100,000 ft. Weight of complete unit is two pounds, it measures three inches in diameter and is as much as long. Motor is 28 v. d.c., constant speed.

Eng Engineering, Inc., 1009 Montrose Ave., Santa Monica, Calif.

Motor for Mach 2 Operation

For motor power exceeding three times the capacity of typical test equipment 1,000-hp without conventional lubrication or cooling is applicable to Mach 2 aircraft and missiles, the motor system.

Compton design is a positive-displacement fluid-driven power device which can compress air to a typical speed of three long-piston strokes three inches high, is 13 in. long, weighs



Small Bomb Hoist Handles Big Loads

New Aero 175A portable electrical hoist can weigh 47 lb., yet is capable of lifting loads weighing up to 2,500 lb. at the rate of 15 fpm. according to Douglas Aircraft Co. engineers, who designed the unit. Used in guns, the hoist can lift 5,000-lb. loads. Aero 175A is designed to lift loads up to 13 ft. within 1/12 sec. accuracy. Normal operation requires a single electrical cable connected to either a derelict receptacle or portable power unit. If there is no power available, a hand crank will raise or lower a 2,500-lb. load. Design for installation on doors loading a large bomb onto a A-10 Hercules internal wing rack.

22 lb. and develops 18.5 hp. Design flexibility permits development of from one to 100 hp. area, it is stated.

Extremely hard, wear-resistant alloy make it possible to operate without need for lubrication. Current three models are designated CM-710, CM-510 and CM-100, these developing 13.5, 9.1 and 4.2 hp. respectively at 200 rpm. and 1,500 rpm.

Manufacturer: Aikensmith Manufacturing Division, The Garrett Corp., Phoenix, Ariz.

Prefiler for PCM

Intake-chamber vertical profile and milling machine has been delivered to the Martin Co. for moving and large detail parts for the PCM Sea-Master transport ship. Both chambers on end plates can be automatically pre-filmed or milled on the machine, which has an electric-hydraulic three-dimensional frame.

Table is 6-in. wide x 12-in. long with a 12-in. wide. Throat depth is 66 in. and maximum movement of cutters head is 60 in. Vertical travel of spindle is 17 in. These cut 16 speeds speeds from 10 to 1,500 rpm. Moore Machinery Co., 385 Lafayette St., N. Y.

Equipment Shake Unit

Shaking electronically controlled hydraulic power, new Hydramaker vibration excitation system is stated to provide more accurate simulation of operating conditions imposed upon engine and structural test specimens. System use Unit was recently developed by



Northrop Aircraft, Inc., and located to current manufacturers. Moving assembly parts of the equipment a high 20 ft. act it has a force capacity effective much greater than other types with similar assemblies weighing up to 275 lb.

Range of capabilities is illustrated by types data: 100G acceleration with 25 lb. specimen weight, 50G with 100

first

Burroughs is first with the full power of a giant electronic computing system at half the cost... the Datatron 200.

First too, a medium-priced system with a full magnetic core memory, increasing productivity 10 to 15 times over previous systems. Designed for both scientific computations and business data processing. Delivery of the Datatron 200 will begin during the 2nd quarter of 1958. For a summary of its benefits, write to Dept. H, Pasadena, California.



ElectroData Division
BURROUGHS CORPORATION
Other models in continuous development extending the usefulness of our system

simplifies several of the stretching compounds, it can be loaded in mold steel, V-mold and new "super" alloys. It is offset in half size of 1 in. through 1 in. short diameter.

Baker Manufacturing, 31 Squads, Calif.

Turbine Wheel Balance

Machine for balancing single stage turbine wheels in various positions sufficient centrifugal force to locate the blades in their operational position. Balance is then indicated on a scale in grams, ounces or any other unit of



selection. Angular position of radial axis is also shown in degrees on a scale inside the housing. Single level controls entire operation cycle.

American Turbine Division, East Grebow Co., Inc., 22 W. Putnam Ave., Greenwich, Conn.

Machometer-Tron Airspeed

Machmeter and true airspeed indicator Model 1005-0100 covers a 100,000 ft. speed range with accuracy of ± 1 ft., in 10 ft. in diameter, in 72 in. long and weighs as pounds. Model 1002-0100 covers a Mach number range of 5 to 15, standard accuracy



NEW, Pyrometer Indicator

Null Balance, Potentiometer Type

MINIMITE

Has 2 1/2 Inch Double Scale



Small Size. Extremely small and compact, fits well between Potentiometer Indicator weights under flow line, and measures only 4" x 2" x 4".

Wide Range. Operates in and from the "Mini-Mite" has a 2 1/2 inch double range scale. There are 15 readable scales for all direct and thermocouple materials. These scales include temperature ranges from -320°F to $+3200^{\circ}\text{F}$ and millivolt ranges from 0 to 42. Accuracy accuracy is 1% of 15 of scale range.

Wide Application. The Minimite can measure temperature directly when connected to a thermocouple, or check other potentiometer or millivoltage type instruments when used as a calibrating instrument.

Write for Bulletin 44-C.

Thermo Electric Co. Inc.

SADDLE BROOK, NEW JERSEY
In Canada—THERMO ELECTRIC (Canada) Ltd., Brampton, Ont.

STURTEVANT TORQUE TESTING FIXTURE



FOR TESTING Springs, threadfastening and (torque) bearing screws—all types of threaded fasteners. Universal gages and threaded connections.

FOR MANUFACTURERS DESIGNERS INSPECTORS TOOL ENGINEERS LABORATORIES and for PRODUCT CONTROL in assembly.

Complete
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100-1000 lb.
1000-10000 lb.
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1000 West 10th St., Chicago, Ill.

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Giannini

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TEFLON®

HOOK-UP WIRE

3 EXTRA STEPS for RELIABILITY

Amphenol's high temperature Teflon Hook-Up Wire is made to MIL-W-88358—an exacting specification that requires rapid manufacturing and testing procedures. In addition to these requirements, sometimes, supplements the specification with even more stringent testing to assure the most reliable wire products available.

In Manufacturing—excessive resistance is a constant check during extrusion of the Teflon to be sure that the insulation is always acceptable.

In Testing—excessive tests are a minimum of 40 microohms above what is in wire.

In Inspection—inspect every foot of finished Hook-Up Wire for reliable operation at rated and higher voltages.

These extra steps are important to users. Consistent insulation provides stress-free strapping-to damage to the conductor wires. The full coverage of silver plating ensures better, easier cleaning—and reliable soldered connections. 300% inspection for dielectric strength is the most effective guarantee of reliable performance—the reliability you must have in Hook-Up Wire.

Amphenol Industrial Distributors carry stocks of standard connector components in order to provide immediate service in your cash requirements.



AMPHENOL ELECTRONICS CORPORATION
division of, General
AMPHENOL CANADA LTD. Toronto, Ontario

for Mach number output is ± 0.01 . Sensitivity of ± 0.01 can be had on special order. Standard units are designed to operate to 60,000 ft.

Unit is part of a complete air data system. Modular construction permits mating with the MTE No. 1051-0180 altitude and vertical velocity meter. M. Ten Bosch, Inc., Pleasantville, N. Y.



Three-Way Warning Light

Warning light for aircraft engine in corporate three functions: flashing light, steady light and position light. Flashes rate at 600 flashes/min. $\pm 10\%$ over the voltage and temperature range. Operational range is from 14 v. to 32 v. d.c. and -55°C to 710°C . Unit meets MIL-K-8144.

Weight is 11 oz. It is low dielectric and requires three inches depth behind the panel.

Jordan Electronics Co., 3025 W. Mission Rd., Alhambra, Calif.

New Vacuum Furnace

New 90-to-160 lb. vacuum induction melting furnace, designated Type 91M 300, features wide flexibility for a wide range of applications, the manufacturer reports. Unit has an 8 ft. long, 5 ft. diameter chamber, a 2,000 W. oil-seal diffusion-pump, a 310-ohm mechanical pump, and control system. Melting is finished, can be built to any desired depth and is easily recharged with help or assistance. Standard well accommodates rods 45 in. high. Melting table permits 45 in. inside.

Charges to be melted are handled by a vacuum-controlled loader which can handle long or bar cast material.

Consolidated Electrochemicals Corp., Rochester Division, 1775 Mt. Road Blvd., Rochester 3, N. Y.

Lex Quick Disconnect

Quick disconnect coupling with and without self-sealing members in each coupling half for use in aircraft based oxygen systems are currently being test of by Air Core Equipment Laboratory, Naval Air Experimental Station, Philadelphia.

Units are made of corrosion-resistant materials and incorporate Teflon or

Need Compact Torque Capacity?

Why aircraft designers specify Formsprag Over-running Clutches for maximum torque—minimum weight

More and more, in modern aircraft engine test, design engineers and manufacturers facing this challenging question: how to pack more and more performance into less and less space.

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They have discovered these mild advantages built into each truly modern Formsprag clutch: more torque capacity with less weight providing greater payload than

any other over-running clutch... high efficiency... unusual design simplicity... no measurable backlash.

Perhaps you too have a project on which the performance vs. size problem could be solved by Formsprag design engineers. Formsprag over-running clutches are widely used as component parts of jet engine starters, helicopter drives, roller and landing gear starters, hoists and hoisting mechanisms. For engineering design assistance simply write Formsprag Company. Ask, too, for the new paper titled "Design Considerations for High Speed Over-Running Clutches".



Over-Running, Freeing and Backdriving Clutches for heavy-duty service in various industrial applications

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2555 ROOVER ROAD, WARREN, DETROIT, MICHIGAN

Mold's direct customer representative of over-running clutches. Distributors in principal cities.

AD 100



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The successful maiden flight of Kaman's pilotless helicopter has opened a new concept in military aviation. Flown entirely by remote control, the variety of missions possible with these ships is almost limitless. Using the Kaman robot as a flying TV or motion picture camera, complete battle-field surveillance and target marking are available without hazard to personnel. Also possible is the entry of the robot helicopter into contaminated or hazardous areas.

The control station is portable and can be operated from the ground or in air to air operations. Mission equipment such as cameras, weapons, target markers and destructors can be actuated at the control station.

Kaman is proud of this forward step which has been taken in behalf of our National Defense effort.

KAMAN

THE KAMAN AIRCRAFT CORPORATION
Bloomfield, Connecticut



AIRFRAME ENGINEERS

As leaders in the development and production of rotary wing aircraft, Kaman offers a solid future to a few specially trained airframe engineers who can qualify for the positions listed below. A friendly company, located in colorful Connecticut, Kaman is young in years and ideas. You'll find this combination the key to a pleasant, profitable future.



AIRFRAME DESIGN ENGINEERS

Responsible for major phases of air frame structural design of a high order of complexity. Minimum of 3 to 5 years in airframe design required.



AIRFRAME STRUCTURAL STRESS ANALYSTS

Must have 4-6 years intensive experience in structural stress analysis of definite complexity, such as stressed ribs, fuselage and bulkheads and other major fittings. Work requires familiarity with materially indestructible structures.



WEIGHTS CONTROL ENGINEERS

Minimum experience 4-6 years design with all aspects of weight control engineering. Some preliminary design through the production phase.



AIRCRAFT ELECTRICAL ENGINEER

With experience in design of AC and DC power generation and distribution systems and in low voltage wiring (400/28) of aircraft and associated systems.

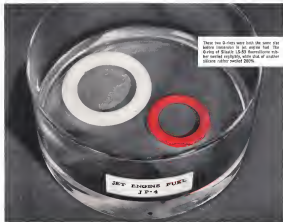


AIRCRAFT EQUIPMENT ENGINEER

Experience required in selection and installation of aircraft furnishings. Working knowledge, servicing and/or instrument experience desirable.

If you qualify, rush your resume to:
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Kaman Aircraft Corporation
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Bloomfield, Conn.

KAMAN



These two 3-lb. rings were both the same size before immersion in jet engine fuel. The O-ring of Silastic LS-53 fluoroelastomer rubber retained rigidity, while that of another silicone rubber swelled 200%.

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now resists fuels, oils, solvents

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Typical Properties of Silastic LS-53 (cured 24 hours at 300 F)

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• Break-free, %	—90
• Solvent Resistance, % swollen	
ASTM No. 1 OIL, 22 hrs @ 300 F	3
Jet Fuel JP-4, 15 days @ 350 F	38

If you consider ALL the properties of a silicone rubber, you'll specify SILASTIC

Write to:
Silastic

Dow Corning CORPORATION
MIDLAND, MICHIGAN

Seminar to Emphasize Collision Prevention

Sessions on personal warning and signaling for navigation (radar), anti-collision lighting, obstacle enter and leave (beacon) from analysis of accident collisions will receive the most attention at the annual International Air Safety Seminar at Pale d'Alba, Châl, Nov. 11-15.

Panel meetings on human engineering, design safety engineering and seat design concepts will also be included, as will vertical flight and intra-company communications with regard to special-use air safety doctrine. On the final day, David Little of American Airlines will discuss progress in air-traffic operations; Capt. E. L. Boudier of British Overseas Airways Corp., and A. M. (Tex) (Johnson of Boeing will talk on future jet operations, including transatlantic training and pilot selection.

Some 350 air safety experts from the U. S. and abroad are expected to attend the seminar, which will comprise closed sessions for the next part Flight Safety Foundation, 405 French Ave., New York, N. Y., is sponsoring the seminar.

Atomic Isotope Tubes Measure in Millionths

Atomic isotope tubes providing highly accurate light sources for measuring to fractions of millionths of an inch are being tested by an industrial firm cooperating with the U. S. Bureau of Standards. Progress seeks to develop a practical device for industrial use to provide absolute measurement to a tenth of a millionth of an inch.

Stitchfield Corp., manufacturer of gaging and measurement instruments and systems, has acquired two Krypton 84 atomic isotope tubes developed by West Germany's Bureau of Standards (Physikalisch-Technische Bundesanstalt) for use as an interferometer.

Temco Engineers Fill Science Teacher Gap

Dallas-Temco Aircraft Corp. is providing equipment to teach physics to 95 students in four high schools in the Dallas area in an effort to give students a better chance for academic careers.

Without computer help the schools would not be able to provide physics courses because of a lack of teachers.

Company decided to provide part-time instructors for the four schools so that students with the talent and desire wouldn't be barred from higher education and technical careers because of a lack of physics courses.

the
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of the
family



The Couch Type 4A relay leads a family of rugged or bits — relay that can withstand the extremes of shock, vibration, and temperature — all because of a unique patented rotary armature design. The 4A design will assure your dry storage switching problems too. Our Relatix 100 will tell you more. Write for it today.

IMPORTANT SPECIFICATIONS

Controls: 4PDT (4 Form C)
Size & weight: 10 1/2" x 4 1/2" x 2 1/2"
Pull-in power: 1/2 watt
Ambient temperature: -85°C to 125°C
Vibration resistance: 200-5 to 1000 cps
Shock resistance: 750 g spanning 2000 ms-spanning

Highlighted on the right are some of the many possible switching variations possible.

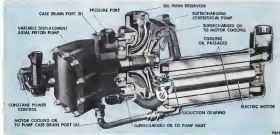


ORDNANCE INC.

A Subsidiary of S. R. Couch Co., Inc.

2 Arlington Street
North Quincy, Mass.

New Vickers OIL COOLED Motorpump For Continuous Duty Applications



**Installed weight approximately 25% less;
also offers significant size reduction**

The 12 horsepower oil-cooled motorpump shown above weighs 315 lb. and is a 20" long overall. This represents a substantial saving in weight and size over the conventional air-cooled motorpumps. Also, there is a further saving with the elimination of duct work in the airborne normally required for air cooling the electric motor. The motorpump, illustrated in more in quantity production for turbine-powered transports.

The time-proven Vickers variable displacement piston type pump, which is an integral part of this "package," delivers up to 5 gpm at 2500 psi, reduces to 5 gpm at 2000 psi and zero flow at 2000 psi. These flow and pressure capabilities (5 to 5 gpm, 2000 psi) provide constant horsepower for a variety of light operating requirements. It is designed for 3000-hour service.

A centrifugal boost pump is located between the pump and the 400 cycle, 300 v. electric motor, as well as a supercharging pump, a cascade of through the variable-displacement motor pump. Cooling oil from the motor jacket is discharged into one case drain port (A)... then out port (B) to a heat sink. At full pump flow, the impeller provides 5 gpm to the motor cooling.

The 12 horsepower unit described above is typical of the Vickers motor and pump combinations now available to the aircraft industry as "package power" for continuous duty applications. Remarkable records for reliability in

both military and airline service have been established by Vickers designed motorpumps.

Higher Overall Efficiency

Overall motorpump efficiency (hydraulic power output to electric input) is 75%. This is possible only because Vickers Pump Pump has an overall efficiency of 65%. The more efficient pump means the use of a smaller, lighter electric motor, minimum heat transfer to the hydraulic circuit, and less current draw.

Heat Rejection Control

The oil-cooled motor pump design offers a definite advantage in that heat dissipation (140 Btu per minute, maximum) can be controlled readily in a controlled heat sink. This is not possible with systems performing by a given weight and size is more readily achieved in a liquid cooled unit.

High Altitude Operation

Motor operation is not affected by low air density since it is not dependent upon air cooling. In addition, centrifugal boost pump provides piston pump assistance above 50,000 ft, even though motor is not required to drive it.

Constant Power Control

The constant horsepower control shown on the above unit is optional, depending on the application. The control maintains constant 2000 psi pressure at flow increases until the electric motor is loaded to its maximum horsepower. Additional flow is then available at reduced pressure to maintain the same

horsepower load on the motor. This type of control is particularly advantageous for low flow, high capacity (flow) and high flow, low capacity applications while staying within the limits of recommended electric motor load ratings.

Packaged Unit

The total system pump, centrifugal boost pump, reduction gear and electric motor are all integrated into an exceptionally compact and high-performance package. This concept eliminates a high degree of design flexibility to meet individual requirements.

Sound Insulated

Because no ducts are not needed to dissipate heat, the oil-cooled motorpump can be sealed in a compartment and effectively sound insulated.

Additional Advantages

Low frictional starting torque, ease of maintenance of the 12 horsepower unit permit acceleration to maximum speed in less than 200 milliseconds. The electric motor meets the military specification for engine proof operation.

For further information contact the nearest office listed below.

VICKERS INCORPORATED

DIVISION OF SPERRY RAND CORPORATION

Rare Hydraulic Motors

Engineering, Sales and Service Offices

Philadelphia 1, PA 19104

Superior 12, Chicago

Patent 22, Michigan

Patent 22, Michigan

Patent 22, Michigan

Patent 22, Michigan

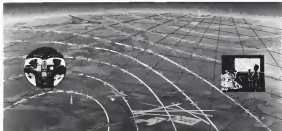
Patent 22, Michigan

Patent 22, Michigan

Patent 22, Michigan

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AVIONICS



RADIO WEB, type-holic navigation system developed in France, may also provide traffic control, collision avoidance and selective calling features. System has been provided by France at current ICND meeting.

French Radio Web Enters Navaid Race

By James A. Faxon

Montreal, Canada—A new concept navigation system that not only tells the pilot where he is but can also display to him positions of nearby aircraft and, additionally, display on the ground for air traffic controllers the positions of aircraft in their control area, has been presented here.

Called Radio Web, system has been offered for consideration as a selected alternative navigation aid by French delegates to such Communications Division meeting of the International Civil Aviation Organization. Stated Engineering, Inc., Plainfield, N. J., creator of Radio Web in U. S. and Canada, is at present actively seeking U. S. military and civil support for the system.

Test System

Radio Web has been developed by Col. Pierre Gaudin, director of the Societe Francaise de Telecommunications, under a contract between the French government and the firm Radio A. I. B. An experimental set of four transmitters has been set up near Paris and a prototype airborne unit flight tested. Now being assembled are a ground station control unit, and ground, warning and chart display devices for airborne installation.

The basic techniques of Radio Web can be used over a wide range of operating frequencies, from very-low

frequencies (VLF) to ultrahigh frequency (UHF). Present experimental Radio Web is French operates in the microwave frequency band, around 2,000 Mc.

For medium and long-range service, the frequency probably will be in the 90-100 Mc. band, the same used for Navaid and Loran-C (GTC).

Fifteen ground stations, operating in the 90-100 Mc. band, could provide complete navigation coverage of the U. S. and provide an accuracy of within 1 mile, according to Stated engineers. (See sketch, below.)

Distance between stations in the arrangement is 500 mi. and the required power is estimated at 100 kw. For transonic operation, a distance of 2,000 mi. between stations along the route would give an estimated accuracy of 1 mi.

Although no airborne equipment has been designed yet for commercial use, Stated estimates that a specially equipped and private turbine engine, providing only position-control information,

can be built for less than \$1,000 and will weigh less than 10 lbs. For airborne radio-type equipment which includes the additional features of the system, cost is estimated at about \$5,000 and weight at about 60 lbs.

Information Available

Stated engineers state that Radio Web is unique among presently proposed systems for air navigation in that it is the only system that is capable of providing information on the following types of information:

- **Navigation:** The airborne equipment permits the pilot a continuous and instantaneous indication of aircraft position. Depending upon use, cost and complexity of airborne equipment, air plane position can be shown on a chart display such as the Domes Flight Log, an bearing and distance to destination, or in position coordinates on digital counters. The latter may be selected in a chart to obtain aircraft positions. Radio Web enables pilot to be selected route and is not adversely affected by increasing density of aircraft in the area.
- **Traffic Control:** System provides a radar-like display for the ground traffic controller that shows his position of all aircraft in his control area equipped with a transponder beacon, and permits him to communicate selectively with any one of the aircraft.
- **Collision Avoidance:** All receive aircraft equipped with transponders can



Radio Web station coverage of U.S. by Radio Web.



B.W.F. (Fig. Bob) Schmidt, Manager, Tucson Airport Authority

There's a team in Tucson worth knowing about!

Big Bob Schmidt and Shell, working together at Tucson, Arizona, Airport have increased aviation fuel sales fivefold since 1948!

Seems everything's big at the Tucson Airport—Big Bob, big sales . . . and big plans that are underway to extend the 12,000-foot runway to 15,000 feet, making it the longest in the world!

"One of the things that attracted us to Shell," says Bob, "was the company's reputation for helping dealers grow. We knew there must be good reasons for it. We soon found out. Giving engineering and other specialized assistance to help dealers build for the future is one secret of Shell's position as an aviation supplier.

"For example, when we needed more bulk space, Shell engineers designed and supervised the construction of storage facilities.

What's more, Shell's technical representative is always here when we need him, making our job of keeping our customers satisfied a lot easier."

And at Tucson, customers are satisfied. Pilots know that a Tucson stopover means a lot more than sunny weather. Big Bob gets them in and out again—fast! He delivers the kind of service they need for on-schedule take-offs every time.

Responsibilities fall on Bob Schmidt when he's away from the airport too. Bob is president of the National Foundation for Asthmatic Children, president of the American Association of Airport Executives, a director of the Tucson Metropolitan YMCA, and chairman of the Y's Southside Branch.

Shell is constantly on the watch for men who can build careers to match that of Bob Schmidt.



Corporate plane takes post-coated tower on way to special parking ramp. New operations building and two-story tower are under construction.



Big Bob and Shell representative "Nobby" Netherer stand near bulk storage tanks discussing plans for still further expansion of airport facilities.



Speedy ground service is provided for large airlines landing at Tucson. Efficiency results in on-time take-offs.

It pays to be a Shell Aviation Dealer
—and the Shell office nearest you will be glad to show you why



To engineers who want to straighten
out the curves in their careers...



**DOUGLAS TEAMWORK
HELPS TO RELIEVE
ENGINEERS OF
BURDENSOME
PROJECT DETAILS!**

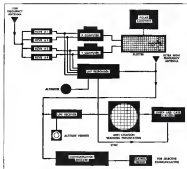
There are no "dead end" jobs at Douglas. As part of a crack engineering team, you'll be encouraged to use your full talents. Important assignments will give you the opportunity for greater accomplishments and the kind of future you want for you and your family. Wherever you choose to locate—in California or across the nation—Douglas offers many career opportunities including...

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DOUGLAS AIRCRAFT COMPANY, BOX 880-M
SANTA MONICA, CALIFORNIA



PHOTOED ground control end for Radio Web

could include, in addition to the above features, the proximity warning display and a ground control unit to open the aircraft's communication receiver when signaled by the ground controller.

Transponder beacons are all to be equipped with coded and color-coded altitude information for transmission of altitude information. With all this oceanic information in the same thread, relative altitude between aircraft can be determined even though absolute altitude cannot (because of standard changes in barometric pressure). Altitude information would be transmitted either by changing the pulse width of the transponder beacons or by a shift in the beacon frequency.

Pilot Steps

A pilot entering a particular Radio Web coverage area or traffic control area would first tune each of the four channels of his receiver to one of the ground stations, then set the transponder beacons to an assigned frequency. (See sketch above.)

The ground controller assigned to a particular altitude station will have set his receiver to display only those aircraft whose transponder beacons display place them in his sector. As mentioned, he can selectively call any aircraft on his display by moving a pointer to point to the target blip of the aircraft on his display.

In the future it will be possible to

attach a computer to integrate the position information of all aircraft in the area to obtain course information and to determine whether any aircraft are in collision courses. David believes

Principles of Operation

Each of the four transmitters of a basic Radio Web network transmits on a different carrier frequency, modulated at different but very closely spaced audio frequencies.

If an observer standing on a baseline connecting two transmitters were able to physically see the airplane, it would appear to start at one transmitter, move along the baseline until it reaches the other, then repeat the cycle—always appearing in the same direction. The airplane moves from one transmitter to the other at a steady rate, called the scanning speed, that depends on the difference in modulation frequencies between the two stations. The time interval between passages of the airplane in the scanning speed.

Ambiguity Guard

The modulation frequencies are so chosen that there is only a single phase line at any instant between two adjoining stations, in order to prevent ambiguity in the system.

The signal transmitted from each station travels outward in a circular direction. Therefore, the airplane does not extend to either side of the baseline as a straight line but as a curve (hyper-

...almost
weightless

(3 of 4)



Gianni

TRUE-TRACE

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TOOL
CONTROLS**

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Greater production
and increased profits
 thru 1, 2 and 3 slide
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rulers and numerical
controls.

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SALES CORP.**

87 Main St., Cold



Chop weight, get thinner sections with Alcoa high-strength castings

Reduced weight and higher strength are now existing realities. Thinner sections, lighter parts are now possible. Castings can be stressed to new limits. Alcoa's new high-strength process guarantees you high properties.

Formerly, the properties of a casting were based on separately cast test bars. In design and application, a casting factor had to be applied to relate these properties. With Alcoa's new high-strength casting method, properties are based on bars cast right from the casting itself. No reducing

necessary. And, best of all, the guaranteed properties are all the castings in the run... consistent, guaranteed, high properties in castings for aircraft structural parts.

New carefully controlled boundary practice and improved alloys are the development responsible. The alloys are A356 and C355. These are the same composition and meet specifications for familiar alloys 356 and 355, with one difference. Impurities are controlled to a new minimum. Iron content, for example, is held to

4.2% as the improved alloy. Such seemingly minor changes make a world of difference.

Quality control is at all steps of the boundary process, plus several new Alcoa developments in aluminum boundary technique, is also vital in making these high-strength castings.

High-strength castings can be made in sand or plaster mold... sometimes in permanent molds. Alcoa's standard guarantee of properties for alloy A356-T6 is 36,000 psi tensile, 26,000 psi yield, and 15% elongation. Occasionally, because of stresses, shapes and designs, high strength can be furnished only in certain areas of the casting. But, by working closely with the designer, Alcoa can usually put the high strength right where it's needed.

Your Alcoa sales engineer has the facts on this new process. Let him work with you in obtaining castings with high properties—properties that don't have to be reduced in application. Aluminum Company of America, 1500 Alcoa Building, Pittsburgh 19, Pennsylvania.



MOVEMENT of the propellers.

(a) which changes its form in proportion to the distance the two spools have traveled (See sketch above)

Position Micromoving

The four stations of the basic Radio Web system are set up with each transmitter synchronized with the one directly opposite, so that the four positions sweeping the coverage area are synchronous. For example, in a telephone system from west to east would start and finish at the same time or east moving from east to west.

The airborne receiver determines the position of an aircraft by measuring the time interval between the arrival of the two pairs of signals. For example, if all four signals were received at the same time the aircraft would be in the exact center of the coverage area. The position lines obtained in this way form a fairly regular grid which can be overlaid on a map or used with a slightly distorted map. (See sketch below.)

Position Determining Method

In the basic Radio Web system described previously, the receiver moved steadily from one station to the other by the position determining method used with the ground control display unit. The Radio Web stations do not transmit continuously but rather transmit pulses. Operation of the airborne equipment is not affected.

While the transmitters are pulsed

There's more PULL built in Sensenich Propellers

Now FIXED PITCH METAL CAA approved up to 165 hp.
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Get all the facts... write for Bulletin and Price List.

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Serving the Aircraft Industry for a Quarter of a Century



Important notes in structure of castings for Douglas Aircraft's high-strength casting process and alloy A356-T6 are that some of the alloy properties are cast. Here are the properties obtained on test bars cast from the castings.

Temple, in.	Hard, in.	Elongation, %
From Casting		
A356-T6	34.1	9.7
A356-T6	34.1	11.8
A356-T6	34.1	12.1
From Casting		
A356-T6	34.1	9.7
A356-T6	34.1	11.8
A356-T6	34.1	12.1
From Casting		
A356-T6	34.1	9.7
A356-T6	34.1	11.8
A356-T6	34.1	12.1



Your Guide to the Best in Aluminum Metal

HUNTER HEATING SYSTEMS FOR MILITARY APPLICATIONS

Heater heating systems are used for a wide variety of military applications. They are standard heating and ventilation equipment for many types of military vehicles, military engines, generator sets, etc. and are designed to conform to military draft fuel requirements.

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for mobile or portable military use, for heating, cooling and providing remote control and maintenance facilities.

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for starting internal combustion engines at sub-zero temperatures, for starting generator sets, and for emergency use.

HUNTER SPX TORCHES
for a wide range of applications at sub-zero temperatures. An unpowered open flame burner capable of being lighted with a match and operated on conventional fuels at temperatures down to 100° below zero. Capacity range—from 15,000 to 200,000 BTU.

Write for Folder 18-8126 "Heater Development and Production Facilities"

HUNTER Manufacturing Co., 20501 Aurora Rd., Glen, Ohio
Heating and Refrigeration Systems

SQUARE dimensions given



3-minute check-out for jets

Our system for testing guided missiles before launching can be applied with equal practicality to checking the standby readiness of jets.

With an adaptation of test equipment we have already produced, one man will be able to check out a jet in three minutes. This application to jets is now only a matter of cooperative development.

The system will be compact and mobile and will utilize the latest digital and analog control system techniques. Test sequence and acceptance limits will

all be programmed in advance. An "umbilical" cord will be used for plug-in connections to an associated output jack on the aircraft.

The system will automatically perform the tests, evaluate the responses, and—in three minutes—either check out the plane for flight, or call for replacement equipment.

We would welcome the opportunity to discuss application of these techniques to any similar testing problem.



STROMBERG-CARLSON
A DIVISION OF GENERAL DYNAMICS CORPORATION
RADIO OFFICE AND FACTORY at Bethesda, B. D.—and Plant at San Diego and Los Angeles, Calif.



mechanically, the nephos moves in small steps or jumps. As proper timing of the pulses, these steps of the nephos do not overlap, but are close enough together to prevent holes in the coverage.

Because the two signals that form the nephos meet first on the baseline within a very small area which results away from the baseline very rapidly as the signal nonchord advances, a focusing effect is obtained. When a beam signal is received at the ground control unit, position of the aircraft is determined first, by how many steps along the baseline the nephos has had time to take and, second, the distance along the curve (hyperbola) that the scanning spot has traveled in the intervening time. Because the time between steps of the nephos is longer than the scanning time of the spot, the two components can be added to give position.

Position Indication

The Radio With FFI at the ground control station is electronically scanned in synchronism with the stepping of the nephos and scanning of the spot so that the time of arrival of transponder reply gives direct indication of position. (See sketch below.)

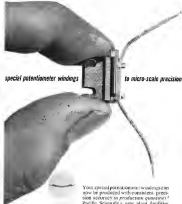
One possible method of reliable indication is to transmit the ground display to one aircraft, informing it of the position and course of nearby aircraft. An alternative is to use an automatic cockpit display, similar to that employed on the ground, which is directly operated by transponder replies from nearby aircraft.

The experimental Radio With network of four stations has been set up in Cal Goodhue under a contract awarded by the French government. The transmitters are located in the form of a square with sides about 60 mi. in length.

The experimental stations have a rated power of 100 watts, operate in pairs, on carrier frequencies between 1,675 and 1,675.5 Mc. Transmitter A



SPOT Scanning Pattern



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RESEARCH & DEVELOPMENT LABORATORIES Hughes Staff Relations, Hughes Aircraft Co., Culver City, California

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THE "ONE GUNG WOH" PRESSURE TRANSDUCER—is small that 80 instruments won't quite cover that old—pushing-out performance in its 1" wide case.

Developed for the Vanguard Renth Stateline, this potentiometer output transducer provides a high level output proportional to absolute, differential or gage pressures to 50 psi. Resolution is better than 500 wires (0.001%) and weight is less than 3 oz.

For full details, please write for facts sheet.

Giannini

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1881 ГОДА : 1. 12. 17.000. 1882 ГОДА : 1. 12. 17.000.

(located at Miami) is square-wave modulated (pulsed) at a frequency of 384 cps, and transmitter B (at Montego Bay) at 165 cps. Modulation frequencies may be obtained alternatively with continuous confining tuning beds or crystal oscillators.

Transmitter A (Clatskanie) is modulated by a local oscillator locked on the frequency of transmitter B, while transmitter B (St. Ansel de l'Eau) is modulated by a local oscillator locked on the signal from transmitter A.

Modulation frequencies of 339 and 337 cps were selected to provide line widths (measured along the baseline) of one kilohertz (0.5 ms) and a total scanning period of one second. The first transmission generates four isophases which travel at a speed (along the baseline) of 350 km./sec.

One type of indicator for use with the airborne recorder is a dual electronic counter fed by a crystal stabilized 1,000 cps oscillator. The east-west coordinate then is measured as the number of sub-nanoseconds between the passage of one pair of neptunes and the north-south coordinate by the number of sub-nanoseconds between the passage of the other pair of neptunes. These coordinates are then displayed on two counter dials which can be installed on the instrument panel.

A second type of indicator measures directly the time interval between the pulses of the two transmissions at 334 cps, and the interval between the pulses of the two at 335 cps. Then, by eliminating the sum of these two values and the difference between them, it obtains the east-west and north-south coordinates and displaces them by constants as in the first system.

Expansions, Changes In Avionics Industry

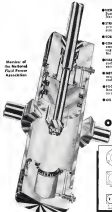
Letten Industries, Inc., will purchase Maryland Electronic Manufacturing Corp., College Park, Md., producer of an ignition coil, radar antennas and tele-
 wiffs equipment. William R. Mares will continue as president of new acquisitions whose sales this year are estimated at \$3 million.

Other recently announced expansions, changes and mergers in the aircraft industry include:

• **Vand, Inc.**, Pasadena, Calif., maker of electromechanical women's devices has been purchased by group headed by John A. Swart, former Ford Motor Co. production executive who becomes new president of Vand Company founder, Vand Wallace, will be employed as a consultant.

•Seglar Corp., Los Angeles, has entered with Unifronics Corp. and the

all the EXTRAS are standard
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- [illegible]

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new method solves DIFFICULT R-F NOISE problem

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Faced with a new version of the same old R-F interference vs. space-weight problem, he came upon a solution that sidestepped the usual time, trouble, and expense... by calling on Sprague.

The perfect solution was found almost immediately among the more than four thousand filter designs already available from Sprague.

Even if his problem had required the weeks of research—special measurements and tests—Sprague field consulting service—he would be no less at ease.

With mass production facilities on both the East and West Coasts, deliveries are no problem either.

If you, too, have an interference problem, pick up your phone and call your nearest Sprague Electric Field Engineering Laboratory.

They are located at 12870 Panama Street, Los Angeles 66, California (TEKas 4-7531 or EKness 8-2791); 234 Lee Street, Dayton 4, Ohio (ADams 9188); 327 Marshall Street, North Adams, Massachusetts (MOChwick 1-5311).

see

SPRAGUE

for filters

Miner Series Reprints

Reprints of Aviation Week's exclusive report on Miner (atomic) amplifiers, their principles of operation, advantages and possible future applications which appeared in August 15 and 22 issues will be available shortly. Price is 25 cents per copy. Address requests to Editor, Aviation Week, 130 West 44th St., New York 36, N. Y.

Hafell Corp., under the corporate name of Scepter, latter is expected to gross about \$75 million this year, about one-third of it in satellite electronics business.

• **Air Products (Great Britain) Ltd.**, a recent off-shoot from formed by Air Products, Inc., of Allentown, Pa., and British Gas, London, England, which will manufacture and market oxygen and nitrogen equipment for British Commonwealth and European markets.

• **Tek-Dynamics, Inc.**, industry producer, has opened new 180,000 sq. ft. computer-manufacturing facility at 5000 Parkside Ave., Philadelphia.

• **Clary Corp.** has consolidated its former Aircraft Division and Automatic Controls division into single unit to be called Clary Dynamics, which will be headed by Paul J. Meier as general manager.

• **Kio Tai Division of Cobe Electronics, Inc.**, San Diego, manufacturer of electronic and controls, will open New York office with E. C. Tichenor as manager.



• **Facsimile by Motor Burn-First** successful transmission of facsimile by new motor burn technique (AW June 17, p. 36) reportedly has been achieved by Radio Corporation of America. Air Force-sponsored tests were conducted over 5000m. path between El Paso, TX, and Riverside, N. Y.

• **"Sero-Robotic" Approach**—To speed design and fabrication of breadboard micro systems, Sero-robotics' Micro-Robotic system will supplement own line of servo components with those of outside manufacturers to provide single source and immediate off-the-shelf delivery of more than 200 components most frequently needed. Company's "Sero-Robotic" approach includes catalog complete with application data line of components will include position amplifiers, potentiometers, modu-



For fast single-point FUELING AND DEFUELING

Weight saving and simplification of fueling operations are achieved through use of FRI GA-2 Adapter. This Adapter eliminates need for additional fueling points and associated plumbing by providing fast, efficient fueling and defueling through the aerial refueling probe on military aircraft. The GA-2 Adapter fits on existing MA-2 fueling nozzles and gives positive check on the operational status of aerial refueling receiver system during ground fueling thus eliminating need of separate check equipment.

Designed and produced by Flight Refueling, Inc., these wingpockets are flight-proven for production installation. FRI components simplify assembly and increase system reliability.

Also Available:



RI CHECK VALVES for aircraft systems are lightweight (less than 3 oz.), reliable, and accurately variable. The CV's are low cost and can be used on standard standard pipe connections or in any low pressure application up to 100 psi. They are designed to prevent backflow and prevent fuel from entering the system. These light weight valves are positive sealing and feature low "backflow" pressure and low pressure drop. Design makes it practical for use with most fuels and gases. Operating temperature range is -60° to +150° F.

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For simplified fuel system components to your specifications, contact Flight Refueling, Inc. Many products stock immediately available.



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**Baroudeur
Performs at NATO
Evaluation of
Tactical Fighters**



Landing (opposite page) and takeoff sequence (this page) of Red Arrows Baroudeur was taken at Brest, France, where NATO is evaluating five entries in competition for a lightweight tactical strike fighter able to operate from unimproved fields. Baroudeur is equipped with delta-wing conventional gear. Reinforced tracks dig into ground, are supplemented by drag chute.





Tan Competes For NATO Role

Report 1001 Tan (above) takes off during recent NATO lightweight tactical fighter trials. Gaupers are visible just under the aircraft's second wing inlet. Rapid ground servicing is beginning below. Note landing light in dark installation on nose wheel door. Lang has pressure tires and is used to aid in securing rough field operations.



How magnetic tape converts blueprints to parts

From numbers to metal without templates or models



Photo Courtesy of Lockheed Aircraft Corporation

"This part was made with 'production tooling' that cost less than conventional machining on a single template. The 'tooling' was a reel of magnetic tape programmed from blueprints by computer and electronic director. In a kind of machine they block design, the part sprang into being on a Giddings and Lewis Numerically Controlled Milling Machine. Much larger parts are also readily made on this same tool."

NOW AT WORK IN ACTUAL PRODUCTION

"This is not just a futuristic experiment. A commercial version has been delivered to a number of manufacturers. The first, at Lockheed Aircraft Corporation, produced 98 different complex parts in its second month of operation. Lockheed is using the tape-controlled mill to improve tolerances, eliminate human error and cut existing costs—often by over 50% (\$5.32 versus \$6.50 per part on one item). It is used for cranks, transmission and other intricate tooling—also for production parts on Lockheed's expensive F-104 'Stallions'."

From initial experience at Lockheed, tape-controlled machining shows promise of reducing lead time from drawing board to production at parts by 60 to 70 percent. Since the "complete sets of tooling" are reels of tape, they can be stored as easily as a row of books. Additional production runs can be made with a minimum of setup.

Earlier, at the Giddings and Lewis factory, tape-controlled milling was used to make out-of-

stock cranks and templates for tracer-controlled machines. Cost on a competitive bid basis was less than 50% of that for same work by conventional means. Recently, this technique today is what universal control will eliminate wherever it supplants tracer-controlled machines.

A SIMPLE WAY TO HANDLE A MILLION COMMANDS

For the economically controlled mill, magnetic tape provides 300 commands per second, each defining exact tool positions in three linear coordinates (regular coordinates try, on some). A maximum signal commands

only 0.000025 inch of tool motion. One reel of tape programs up to 24 hours of machine time.

These closely spaced commands are ideal for a self-correcting system of servo controls. Also they eliminate need for expensive equipment and interchanging equipment in the individual machine. Controlled programming can make tapes for easy machines and it is not tied to the time-consuming repetition of actual production.

With its fourteen tracks, a standard magnetic tape has ample reserve for extra functions. All are used for tool-position coordinates. The others control start, stop, coolant, and even voice instructions for impending tool change. Tapes can even be shared by several functions, allowing still further expansion.



General tape on its Amplex FR-200 can hold over 1 million commands for each inch of tape movement

We will be glad to furnish more facts on magnetic tape recording and its use in machine tool control. Write Dept. UU-4.

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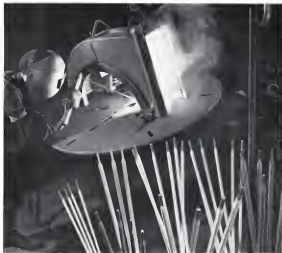
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MAGNETIC
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8





Why **P&H** Low-Hydrogen Electrodes eliminate costly rewelds on "difficult" steels

Alloy steels can be welded right the first time when you use P&H Low-Hydrogen electrodes. That's because the unattached P&H electrode line is industry's largest — enables you to select the electrode that matches the chemical and physical properties of a wide range of problem steels.

This correct combination gives you better impact properties, faster deposition, and deeper penetration. Because these P&H electrodes prevent underbead cracking and porosity, you get high-quality x-ray

welds with little or no preheat and at much lower cost than is possible with higher-alloy electrodes.

To find out more about low-hydrogen electrodes, write to Dept. 324H, Harnischfeger Corporation, Milwaukee 46, Wisconsin, and ask for Bulletin R-26.

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EQUIPMENT



PROTOTYPE Wheel Mover (left) shows two hydraulic pumps which power it, ring gear to transmit power to plane's wheels. Sketch at right shows how Wheel Mover would be attached to main gear wheel. Arm to drive takes oil torque, yokes propeller power vehicle.

Plane's Weight Gives Tow Unit Traction

By George L. Christian

New York-Los fell the concept of propelling heavy aircraft by hooking a torque converter on to the main wheels and using the plane's own weight to provide required traction was put on side (AW Oct 22, 1956, p. 62). But the theory has materialized into operating hardware.

Equipment has been designated "Wheel Mover" by its designer and builder, Consolidated Diesel Electric Corp. Inside consists of power vehicle and two wheel movers which attach to main landing gear wheels. Wheel mover will begin tests on Boeing's prototype 707 at Seattle Oct. 21.

An Force has established a requirement for this type of component relative to very heavy aircraft.

Equipment was demonstrated recently at Consolidated Diesel Electric's Stamford, Conn., plant where it drove a pair of B-52 wheels at speeds comparable to a maximum of 5 mph forward and reverse against brakes set to simulate (at equivalent of 200,000 lb. inert weight).

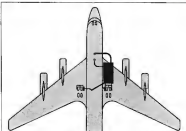
Tough Tow

In recent studies, Con Diesel engineers concluded that "towing by conventional tug or tractor is not a practical approach for aircraft grossing over 150,000 lb."

"For aircraft the size of a Boeing 707 or Douglas DC-8, it has been computed that the dumper pull to stretch the aircraft and offset satisfactory ground movement has to be 16,000 to 30,000 lb."



Low efficiency prototype power vehicle shown with Wheel Mover on pair of B-52 wheels.



DRAWING shows how power vehicle is attached to front of plane's main gear to supply power to aircraft main wheels and as a means to plane's electrical system.



RADAR THAT PUTS THE FINGER ON STORMS

Man's newest ally in his eternal battle with the elements is Raytheon Storm Detective Radar. Already, military versions of this radar are providing invaluable help in tracking destructive storms and in issuing timely advance warnings. Next year 38 new units are scheduled to keep watch around-the-clock for the U. S. Weather Bureau.

Each radar pinpoint station is a 300,000 square mile area, "sees" clouds, snow, fog or probes deep into the heart of a rain-lashed hurricane.

Here is another example of how military and civilian electronics are teaming-up to help safeguard America.



Raytheon is a Division of

RAYTHEON MANUFACTURING COMPANY, WALTHAM 34, MASS.

It. This does not take into account the loss of traction due to wet or icy pavement. Moreover, cost of the conventional towing unit will be high because it must weigh over 25,000 lb., and the use of steel, rubber, cut steel and sheet metal in any vehicle of this type is more than \$1 a pound as to dry's weight."

Consolidated Diesel's conclusion appears to be borne out by Air Force experience with the 150,000-lb. plus B-52. A spokesman at its northern B-52 base told Aviation Week that its usage posed tough tow problems for B-52s.

Current Selection

Standard engine towing unit is a 40,000 lb. Each tractor that can tow weighs well in good weather, as soon as ice hits, line maintenance personnel are forced to hook two, and sometimes three, in tandem to move the big hauler. This is particularly true when the B-52s have to be moved up a 2.7% grade on one ramp.

Other aircraft require deflating tires and making runways for better traction.

The same officer noted the trend in testbeds. Last winter, representatives from USAF's Wright Air Development Center spent a month at his base testing a 2.6 Traction tractor weighing some 35,000-40,000 lb.

As he said, "The use of man-made large units to move an existing unit does not seem to be the logical answer."

He added that, in his opinion, the use of a torque converter which takes advantage of the plane's own weight to generate necessary torque seems to be the correct approach to moving the big plane over icy runways or up grades.

Wheel Mever Operation

How are details of Consolidated Diesel's Wheel Mever system constructed?

- Bottom a trailer up to 5,500 lb. vehicle power vehicle, called model 602 (GPD), and two or possibly four WMC-215 wheel mever units, and a
- Single 250 hp engine, probably a Ford V8 industrial powerplant, will supply power to propel the vehicle to the place and the plane itself after the unit has been hooked up to the aircraft's wheels.

Since the engine is also used to drive a 90 lbs. (or more) alternator to power the plane's electrical system, either while it is moving or stationary on the ramp, the engine will be closely governed to run at a constant rpm as required by the alternator.

Plane's speed will be regulated by slowing the flow of the variable di-

ROCKET POWER PROGRESS REPORT

Taming Rocket Powerplants

by **Walter O. Berchert**



In sheets of the Engineering Development Laboratory as well as the Values and Goals Section at RMI, Mr. Berchert has over a decade of rocket experience. Before coming to RMI in 1964, he was senior project engineer on contract for the Air Force Department of the General Electric Corporation. Mr. Berchert received his degree in mechanical engineering from Stevens Institute of Technology in 1958.

Reliability of a rocket powerplant is the direct result of the simultaneously correct operation of all of its elements. Generally, this is assured by exercising each element's own pre-launch development program. Among these elements is one type which has the interesting property of being composed of several components, yet whose operational characteristics are significantly only in the performance of the entire powerplant system. This element is the control system.

Present powerplant control requirements are based on those straightforward, simple considerations:

1. Prepare the powerplant for firing.
2. Separate and control the system to rated thrust.
3. Very short rapidly and safely as required.
4. Shut down smoothly.

Step one may require the use of gas pressure regulation and relief valves to push the propellant safely from tanks to pumps. These must be switched and relays to relieve or control the valves which adjust propellant to the gas generators and combustion chambers, and flame delay circuits to ensure correct amount accumulation of propellants.

In step two, ignition and combustion may be monitored to insure correct use of the high energy release rates. Further may be safely brought up to speed by throttling the propellant. Safety devices may be added to limit over-speed and avoid the danger of structural failure.

In step three, a controller (it may be hydraulic, electric, pneumatic, or a combination) is used to vary thrust. Here multiple loop servo systems are sometimes used to insure that thrust change rates, turbine speeds, vehicle accelerations or terminal velocity, and other parameters vary in a coordinated manner.

Finally, in multiple stage powerplants or piloted vehicles, the rocket engine must be shut down safely and the system automatically purged of residual combustions.

The successful implementation of these four steps involves the application of many devices of unique characteristics whose individual selection is ultimately tied to the following question:

"What is the actual control system problem to be solved?"

Once this question is clearly and consistently defined, a tight performance envelope results. This enables the few possible solutions fairly obvious. The final stage is to apply the knowledge of a team of control specialists and proceed through the usual component development stages. As RMI, men have of specialists in controls engineering is made up of highly qualified mechanical, electrical and chemical engineers. These professional men have made experience in the control of control units and systems for rocket powerplants as well as other types of propulsion systems. However, there is a continuing need for qualified graduate engineers, able to participate in working closely with other groups of specialists, integrating the control system into the overall engine performance envelope.

The systems engineering is of extensive importance to successful rocket powerplant control efforts. It is a standard approach of the RMI Controls Division. Sequence system design, switching circuit analysis, human engineering, feedback control methods, structural procedures, information theory and latest research data on fluid flow control are among the techniques used. They are applied along with practical design concepts which result in the development of simple but effective control systems.

If you desire one or more reprints of Mr. Berchert's article, or would like to receive further information about employment at RMI, write to me: Telecommunications Services Coordinator, Raytheon, Motors, Inc., Ford Road, Denville, New Jersey.



LAND-AIR ENGINE

Analyzer

Low MAINTENANCE COSTS
improved FLIGHT SAFETY with engine
ignition and vibration analysis —



■ This is representative data which shows engine vibration and fuel system pressure. Accuracy is only 1000 to 10000 RPM. Accuracy is more than 1000 RPM. Accuracy is more than 1000 RPM.

THE Land-Air Engine Analyzer is designed to be compact and to afford every possible convenience for the operator. All controls have been brought together into a single control package. This means that the operator never is required to take his eyes or hands off the instrument for a single instant during an actual analysis operation.

The analyzer model can be located on the flight deck of an aircraft while the ground portable model can be used at normally lighted laboratories, test cells, or on a ground.

The Engine Analyzer provides rapid and accurate inspection of engine ignition and mechanical malfunctions during flight or in preliminary examination on the ground. This means longer life for engines and contributes to flight safety.

Simplicity of design, compactness, lightweight, easy maintenance, easy to install and ruggedness are all features of this specially engineered analyzer that has a reputation of being producing a maximum of efficiency.

LAND-AIR Inc.

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THE INFLIGHT 136 AIRBORNE ENGINE ANALYZER for use with high or low tension ignition systems



General Specifications:

Power Requirements—110 Volt A.C.
400 cycle, single phase.
Power Requirements (Gndl)—220
volts.

Test Voltage—Low (50-100 V.D.C.)
Means to connect all the requirements
of test voltage (A.C.G.) and test voltage
(D.C.G.) (D.C.G.)

The INFLIGHT 136 incorporates the
engine ignition and fuel system
analysis module. This replaces the
number of individual units and ex-
isting required for a complete system.
The instrument displays information
on the fuel of a cylinder test table
with battery of fuel which can be
in flight primary and secondary fuel
system. It also displays fuel system
analysis, including spark advance or not,
distributor spark advance, prop. spark
characteristics, etc.
(See chapter in the Ground Portable
Engine Analyzer)

placement hydraulic pump driven by
the engine. Similarly, the speed of the
vehicle when being driven to and from
the plant will be regulated through a
variable displacement pump driving the
unit through an automotive-type oil
transfer.

Consolidated Diesel anticipates no
problem in supplying accurate and
clinical power measurements. Diesel
own power requirements are present
a problem which could require pro-
cessing to solve.

The power vehicle will be of low ad-
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up with the plant.

Powering power for starting the
plant's jet engines can be supplied by
a permanent power pool mounted on
the vehicle without any structural need
changes. Permanent power source can
be a gas turbine compressor, engine
driven high speed blower or air bottle
with an air heating attachment.

Plant's air conditioning system can
also be powered by the gas turbine com-
pressor.

Operation Sequence

Assuming an aircraft arrival, here a
how the wheel motor system would be
put into operation.

As soon as the plane has landed off
the main runway to a holding area for
enough time to prevent traffic jams
the power vehicle is driven up. While
the pilot is going through his engine
check-down procedures, two men wheel
the power cart to the plane and back
the wheel motor to the plane's wheels
in one minute.

Connect also to attach the power
vehicle to the plane's right main gear
by inserting a long metal arm through
existing tow legs. Vehicle would be in
front of the wheels. Right side arm
chain to turn the vehicle away from
passenger loading facilities which have
been constructed on the left side of
most new planes.

Wheel motors are attached to four
of the plane's eight main wheels. On
the 707, plus is to attach units to the
four wheel wheels, two front and
two rear. In this manner each pair of
front and rear wheel motors can be
mechanically connected so that each
acts as the other's backup motor.

On the DC-8, the rear wheels of the
barges will be free to rotate, or back
through an act of approximately 40
deg. making the low-speed wheel
motor over-rotation capability (DC-8)
can back into using wheels to get around
this problem. One suggested solution
would be to put the wheel motor on
the plane's four front wheels. These
major motor barges could be fitted
into the hubs of the rear wheel units.

Power from the wheel motor is
transmitted to the plane's wheels
through a spur gear to the wheel motor

SOMETHING NEW IN THE SKY!



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implicitly permits substantial savings in weight, space,

and ease of maintenance without sacrificing passenger
comfort. The Starest reflects Hardman's years of
design-manufacturing experience. It sets new high
density passenger comfort standards for any aircraft.

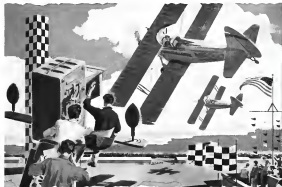
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Realism in the movies with daredevil flying

When a movie script calls for pilots and planes to perform daredevil flying of the early 1930's, the producers often call on Joe Penner. Headedown flying of outland aircraft in aerial and water work for him. Operating out of the Santa Monica Airport in California, he and his fleet of 1930 vintage airplanes have appeared in many motion pictures based on early-time flying adventures.

"Hollywood makes two strong demands when shooting a flight scene," reports Mr. Penner. "One is full power for realism and the other is minimum maintenance problems to eliminate production hiccups. I get both with

Standard aviation products. Chevron Aviation Gasoline burns clean, never fouls the plugs and gives me the extra power I need for movie stunt flying.

"RPMA Aviation Oil keeps the aircraft in top condition and holds engine wear to a minimum. Rugs and refers any claim as sure. You had no engine trouble using RPMA—and as my kind of flying that's saying a lot."

Mr. Penner's fleet of 37 year old planes, the largest such group of aircraft still flying, includes a restored and modified Pietenar four seater, Phillips Skyhawk, Davis DPL and a Panchard 22.

We take better care of your plane



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TIP OF THE MONTH

Avoid flying immediately below or above a cloud formation. Neither is a good place to be should another airplane suddenly pop out of the overcast.

1937

20 YEARS OF PROGRESS

Bendix-Pacific

Pacific Division of Bendix Aviation Corporation has two decades of knowledge under its belt. During the first year of its existence Bendix-Pacific was proud to supply its equipment to three aircraft manufacturers. Now, in 1957, Bendix-Pacific hydraulic, electronic or electro-mechanical components and systems are specified by all major U. S. aircraft companies and are in service on every modern aircraft, on all different types of military planes and on the large majority of missiles and pilotless aircraft. Bendix-Pacific has earned this leadership through twenty years of pioneering achievements: its latest developments in advanced systems are proof of the diversity and flexibility of Bendix-Pacific engineering. The results can be measured in greater performance for you.

BENDIX PACIFIC DIVISION

Emery Aviation Corporation

20 YEARS
in aircraft hydraulic systems

North Hollywood, California

24 YEARS
in aircraft slide mechanisms

20 YEARS
in aircraft electronics

11 YEARS
in rockets

40 YEARS
in missile guidance



Picture: "Flying Saucer" shown here for the Zenith Lightair W-2 Composite

Bring your tough ones to Zenith

This giant Rotocolor was an engineering nightmare. It represented a whole new concept in Earth-Warming-Roller equipment. Its weird shape and great size—30 feet in diameter—were a radical departure in rotocolor design. It had to contain high strength with light weight so that it could be mounted in flight with the roller system.

Working in close cooperation with Lockheed's engineers, we made the Rotocolor of resin-bonded glass fiber. It met every requirement for strength, weight, and electronic conductivity. And the entire job was completed—designed,

engineered, toolled, fabricated, and delivered—in 135 days.

This is the kind of challenge we welcome at Zenith. We've learned how to design resin bonded glass fiber in almost any shape and size—in production-size speed. We can simplify designs because structural glass fiber eliminates the need for interior bracing. We can easily complete tooling in a fraction of the time needed for metal parts—and at lower cost.

Zenith's reinforced plastics are the only manner for some structural components—and a better answer for many. We invite you to "bring your tough ones to Zenith."

Zenith Plastics Company

1400 West 138th Street, Berwyn, California
 Subsidiary of American Mining and Manufacturing Company



engaging a ring gear attached to the outer rim of the main wheel.

Gen Diesel explains that Boeing has already installed the ring gear on the prototype 707. They require the only necessary addition to the plane's structure and weigh a total of 16 lb. Boeing Products, makers of the wheel, has agreed to design the air gear into future production wheels, which should reduce the weight.

Prototype wheel centers weigh about 300 lb per unit, production units will weigh considerably less than 300 lb. One team can only lift the curb from the power vehicle to the plane's wheels on their own cuses and attach them with the slight movement of a lever.

Insertion of an electrical cable plug into the vehicle connects it to the plane's electrical system to supply power as soon as the engines are shut down. Popping action also causes the vehicle to be automatically picked up by hydraulically-operated, full-centering wheels.

Pilot is then located the wheel "over" by hydraulic control through the cockpit controls, giving him complete control of the plane's ground movements.

With the controls, the pilot can start or stop his place at will. He can stop it forward or backward as needed. Consequently, he could drive out at wheels backward, the opposite set forward and pivot the plane without any forward movement.

Feature of the system is that, without a tug and a low bar in front of the plane, it can be moved into tight quarters.

Plane also can be controlled by a mechanic who walks beside the plane.

Gen Diesel engineers hope airborne maintenance will eventually be handled solely or controls into the plane to which units can be plugged in. They estimate the weight payload of such a craft could be 10-12 lb.

Advantages Claimed

Gen Diesel spokesmen cite these advantages for their wheel-over-axle system:

- Fuel saved by towing jets with wheel-over-axle will be considerable because of the inefficiency of jet engines at low altitudes and slow speeds.
- Noise and jet blast reduction around passenger terminal area will be substantial in all circumstances.
- Damage to jet engines due to foreign matter ingestion while taxiing will be eliminated.
- Movement of aircraft over wet, icy or snow-covered areas will pose no problem since the wheel-over-axle system is used to provide the necessary traction. Under extreme conditions, it may be to look wheel-reversers to all eight main wheels.
- Cost (about \$25,000) and weight

(about 6,000 lb.) of the Wheel Over-axle system of moving very heavy aircraft is less than any other practical means of doing the job, Gen Diesel officials believe.

• Ground movement of the plane is left with the pilot.

• System can be fitted to any aircraft with little or no modification.

Gen Diesel officials are prepared to put the units into full production as soon as the desired areas. Total development, design, and requirements and completed are ready for starting work on opening aircraft air conditioning system, can be designed to individual requirements.

OFF THE LINE

Three Lockheed Super-G Constellation units to be placed in service by Vanguard between New York and Rio de Janeiro will have eight berths—four upper and four lower—in the main passenger compartment. Passengers will accommodate 65 passengers each.

Aerovox Corp., Middle, N. J., is manufacturing and exporting its Atlanta, Ga., factory in a new building just erected on a site two blocks from the Atlanta Municipal Airport. Facility will house sales, warehouse and service.

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Advanced engineering systems are made possible by the complexity and increasing size of the modern world. It is essential that we get more out of our people and equipment. General Mills is looking for people who can help us do this. We are looking for people who can help us do this. We are looking for people who can help us do this.

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Russians Flew Tu-104A to U.S.

Aircraft which flew Russian delegates to U.S. was an Aeroflot Tu 104A, newest jetliner two of the first jet transport. Lateral has lightsight onto replacing heavy fuselage in order model and old fuselage design airborne has great way to some modern design (above). New jetliner was 78 instead of 50 passengers (SW) low, 12 in 40. Head and side exterior views of the Soviet airplane were taken at McGuire AFB, N. J. where it landed.



are overhaul activities by the end of September. The instrument overhaul shop will begin operation approximately a month later.

Pieces of Luna Electric Motor Co.'s products will not go up as parts of rising cost of raw materials and increasing wages paid employees. Company recently is advised 7,000 present and prospective customers, adding that the situation would be reviewed later time to time and, if any change were contemplated, ample notice would be given. Immediate reaction was an increase in order for the company's electric motor. Luna Electric, Luna Co., is a subsidiary of Consolidated Diesel Electric Corp., Stamford, Conn.

A \$44-million order for gas turbine-powered auxiliary power units and generators has been awarded Solar Aircraft Co. by Air Force's Air Material Command. Sets which will be installed in Boeing KC-97 Stratofreighters will set an independent d.c. power source for the flying tankers for multiple use such as supplying electrical power when the plane is on the ground before engines are started, supplying current for aircraft's engine heaters under Arctic conditions, supplying d.c. power in flight in case of engine-driven generator failure. Strategic Air Command now has seven air refueling squadrons equipped with the units. Other planes using the auxiliary generators include Douglas C-124A, Lockheed C-121C and C-122, and C-123B. Generator set is powered by a Solar designed and built Merit gas turbine which weighs less than 100 lb. and is smaller than a 24-in. cube.

Cummins' CL-25 lightweight reconnaissance plane uses a specially designed refrigerated fuel to speed loading and defueling operations. Fueling can be accomplished at a 100 gpm rate, discharging at 375 gpm. With a capacity

Royal Swedish Navy Orders Vertol 44's



A special committee of the Swedish Navy made a year-long study of helicopter suitable for anti-submarine warfare as well as utility transportation. In the United States they consulted with headquarters personnel of the three armed services, visited helicopter manufacturers and toured military operating units.

At the conclusion of this intensive study, the Swedish Navy placed an initial order for four of the 22-place Vertol 44's, to be augmented later by additional procurements.

Official Navy announcement of the purchase said the choice was mainly based upon the Vertol 44's "good stability in hovering and forward movement, good instrument flight capabilities and excellent maneuverability... positively unlimited controllability for the contemplated missions."

Sweden thus became the fifth western nation to purchase the newly Work Horse helicopter, first choice of the experts for the most difficult assignments.

In commercial or military use the Vertol 44 offers these features:

- Highest useful load, largest seating capacity
- Lowest seat mile cost
- Automatic stabilization
- Instrument flight capability

For detailed information write: Customer Relations Manager

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BUSINESS FLYING

Colonial Preparing Four-Seat Amphibian

Milvik, N. J.—First details of Colonial Aircraft Corp.'s new four-seater amphibian, called the Model C-1 Skimmer, were recently given to Aviation Week by the company's president, David Thornton.

Prototype is nearing completion at Colonial Aircraft's plant at Saybrook, Me.

It is scheduled for delivery to a Chicago distributor, National Aero Sales Corp., during October. Plane's type certificate, which is a scanlon of the type certificate formerly in force for Colonial's three-place C-1 Skimmer, is now pending.

The Skimmer will be about a carbon copy of the Skimmer in design, size and internal appearance. Hull length (23 ft. 6 in.) and wing span (34 ft.) will be identical.

Principal difference will be a switch from the 150 hp. Model Q-536 four-cylinder engine which powers the Skimmer to a 180 hp. Model Q-506 four-cylinder engine. Power increase will allow the plane's weight to go up 700 lb. from 2,160 lb. to 2,860 lb. Because the greater weight will add the engine at lower in the water, fixed wing tip floats will be shortened two inches each.

Price of the four-seater will be \$99,510 f.i.d. limited. New price of the three-seater is \$17,750. Both prices include executive chairman and also of class industries.

Demonstration Flight

A demonstration flight in the Skimmer, which included take-offs and landings on both land and water, gave these impressions:

- **Ground handling characteristics** are good because of the tricycle landing gear configuration, aided by wide track of main gear and relatively low wheel base between nose and main gears.
- **Water handling** excellent. Amphibian can make a smooth sharp turn while riding on its step at 50 mph. (estimated). Then give the plane good short water takeoff potential once it can run downwind until it gets on its step at about 50 mph, then can make a 180 deg. turn into the wind for takeoff, making low run short takeoff run. Such a maneuver is not possible with a float type aircraft.
- **Water landing** makes plane easy to handle in the water at low speeds.
- **Hull design** keeps windshield and side windows almost completely free from spray during water operation, al-

lowing the pilot full visibility at all times.

• **Noise** from the pusher engine is about average for a single engine private plane.

Stretched to Four Seats

More change to the interior of the shoulder wing amphibian is that the Skimmer's instrument panel and pilot's and copilot's seats have been moved forward eight inches. In place of the side-long jump seat installed behind the pilot is the Skimmer, Colonial has added a full-width crash type seat in the Skimmer that is capable of comfortably carrying two large men.

Behind the seat will be baggage storage space located on the plane's center of gravity.

The Skimmer can quickly be converted to a single plane by removing the seat and copilot's seats. In this configuration, plane can accommodate bulk cargo such as pipe in lengths up to 12 ft. and heavy cargo up to 950 lb. Other Skimmer specifications are:

- **Weight**—weight empty, 1,450 lb.; useful load, 950 lb.; normal fuel weight (40 gal.), 240 lb.; gross weight, 2,390 lb.
- **Propeller**—Hartzell forged steel, constant speed.
- **Performance**—stalling speed, 52 mph.

training speed, up to 135 mph; sea level climb, 500 ft./min.; range, 500 miles.

Second Skimmer will be ready for delivery, by December. Current plans are to build the amphibian at a cost a month into at least through April, 1958.

Future construction will depend on orders.

Colonial will also build at least five more Skimmers interspersed with the Skimmers. Future of the three-seater is indefinite and will depend on orders. "We will plan Skimmer production as we go," said Thornton.

North America's Civil Copter Fleet Near 400

More than 350 helicopter are being operated by 85 commercial rotor wing operators in North America, a survey by Aircraft Industry Association's Helicopter Council shows. Some 50% of these operators are using one or two helicopters. The largest, Okanagan Helicopters, Ltd., Vancouver, B. C., is using a fleet of 23 Bell 47s, 17 Sikhs 516, 18 55.

According to available data, the 99 North American operators fleet break down is as follows: Approximately 274 Bell Model 47s, 2 Sikhs 516, 51 Sikhs 14, 8 Sikhs 25 Sikhs 12, 5 Vertel H&RPs and 9 H 12s.



Army to Test L-19A Amphibian

Grumman L-19A fitted with Edo Model 315-2735 amphibian floats will be evaluated by U. S. Army's Aviation Branch at Continental Army Command. Plane is shown just before leaving New York for flight to Ft. Rucker where flight test program will be carried out. Auxiliary float was added to aid in consistent take-offs of boats.



The Grumman F11F-1F "Tiger" is the most advanced version of the Navy's supersonic F11B. Powered by the mighty J-79

turbojet engine, with afterburner, the wing-wing fighter has shown a "marked increase in speed" over the earlier "Tiger".

How fast? How high?

"Pinch waist" design and efficient turbojet of the "Tiger" indicate superior supersonic performance

Unofficially, the F11F-1F "Tiger" has topped the world's altitude and speed records.

Credit this latest in supersonic performance to design concepts like the "taper rule" and to the use of a new and more powerful turbojet—the J-79.

Nickel alloys can take part of the credit too. Incoleg "T" (nickel-chromium alloy) for example, is used to line the combustion chamber. In this service it provides a combination of extremely useful properties: excellent heat and corrosion resistance... strength

and ductility. What's more, Incoleg "T" alloy is a material that's readily fabricated.

Perhaps the properties of Inco Nickel or one of the Inco Nickel Alloys can improve your product. Why not investigate the possibility by telling us your requirements. Just write to Inco's Mechanical Engineering Section. The address is below.

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Surface case

Incoleg "X"

Exhaust case
Afterburner (Incoleg)
Exhaust valve and cone
Exhaust manifold

Incoleg "301"

Exhaust case
Exhaust valve and cone
Exhaust manifold

Monel

Low alloy
Fuel line tubing
Exhaust case

"S" Monel

Exhaust case
Exhaust valve and cone
Exhaust manifold

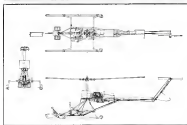
Monel Alloys

Compressor casing
Exhaust manifold
Exhaust valve and cone
Exhaust manifold

Incoleg "70W"

Turbine casing
Exhaust case
Exhaust valve and cone
Exhaust manifold

Monel alloy for elevated and elevated gas. For example, Incoleg 301 is effective element in other materials, like Incoleg 301 in many other alloys.



GOODYEAR AIRCRAFT one-man helicopter is powered by 35 hp, two-cycle water-cooled engine. Features of unit is welded aluminum alloy supported by steel outrigger tubes.

1-Man Helicopter Crosses 490 lb.

Third version of Goodyear Aircraft Corp.'s ultra-light one-man helicopter, Model CA-400B-II, is intended as a production configuration. Extensive development with two previous "Guns" prototypes has resulted in changes in landing configuration, lowering the tail tank and two engines, lengthening the main rotor mast and supporting and redesigning the tail fin.

Advances of welded aluminum alloy tubing is supported by steel outrigger tubes to which the skid-type landing gear is attached. Powerplant is a 35 hp, two-cycle water-cooled Offshoot V-twin & Manufacturing Co. RDHB, which gives the "Guns" a top speed of 55 ft. normal cruise speed of 46 ft. and vertical climb rate of 400 ft. per

minute. Ceiling is 4,000 ft. and endurance at cruise speed is 45 min. allowing 1450 fuel reserve.

Main rotor is balanced about the fuselage and mounted on an aluminum hub underlying from a landing leg.

Main rotor is driven at a 10:1 reduction ratio. Forward thrust is achieved by a 21 reduction ratio wing V-belt.

Basic CA-400B-II characteristics: main rotor diameter, 30 ft., main rotor disk area, 714 sq. ft.; disk loading, 1.52 lb./sq. ft.; overall length (not including rotor), 15 ft. 4 in.; maximum height, 6 ft. Gross weight is 490 lb., empty weight is 390 lb. Fuel capacity is four gallons.

With A



Watchmaker's Precision

Every aviation service, whether it be at the engine overhaul facilities of Dallas Aircraft in Dallas or at the Company's complete fixed base operation at its Island Service Division in Galveston, is performed with the precision of a watchmaker.

These services are many and varied. Dallas Aircraft maintains to be the nation's leader in the overhaul of airplane engines at its extensive Dallas plant.

At Galveston, practically every other service for the airplane operator is available. The Island Service Division performs all types of modifications, maintenance, engine overhauls, fuselage and installation, overhaul for conventional planes and helicopters, and accessory sales, service and installation.

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PRIVATE LINES

Aircraft components manufacturing line led by Janice Hunt will occupy a new 5,000-sq-ft facility at Phoenix, Ariz. Arizona Aircraft (Azzac) plans to eventually build new aircraft. Initially, it will make lightweight aircraft fuselages, airframe assemblies, electrical system components and develop modifications aimed at improving performance.

Waiting list for hangar space was established prior to recent opening of new business and private plane facilities at Metropolitan Oakland International Airport, Calif. Included are 16 T-hangers, four larger hangars with shop space and four executive plane structures. A phone viewing service is included. Also is planned for further expansion, since 300 hangars can be erected in the facility if required. Initial work was built at cost of \$185,940 with part of proceeds coming from sale of \$3.4 million in revenue bonds.

Major price reductions of \$100 to \$200 were made by Safe Flight Instrument Corp. on its speed control equipment. Model SC-14 for multi-engine aircraft was cut from \$695 to \$595, SC-12 for single-engine planes was reduced from \$345 to \$245. . . SFI delivered its 42,011st stall warning indicator to Cessna for installation on a T101. Distributor is now standard equipment on Cessna, Beech, Aero Design and Mooney aircraft, the firm notes.

Advancement into civil aviation modifications and repair work is underway by Lind Air, Inc., with recognition by Civil Aeronautics Administration of firm's Chevrolet Division in a certified repair station covering individual airplanes (Class I, II, III and IV) and rotor (Class V) with limited certification Division, occupying 155,000-sq-ft facility at Cheyenne Municipal Airport. Facilities specialized in military contracts for prototype engineering and installation of electronic equipment in military planes.

Ref for fixed base operations commission at Detroit (Mich.) Metropolitan Wayne County Airport will be opened Oct. 21 by county's Board of County Road Commissioners.

Report of 250 airplanes was made by Cessna Aircraft Co. to 25 different countries in the first six months of 1957, a new record for the firm. Export market continued to be Central and South America, which accounted for 201 airplanes. Total breakdown by model: Exported 16 Model 170s, 58 Model 172s, 69 Model 180s; 65



Readable Plane Tested on West Coast

Three-place Aerobike undergoing flight tests in California is heavily armed, unmodified version of proven Waterman Aerobike designed to meet Dept. of Commerce competition for "safe 1700 airplane" in the mid-1950s. New version pictured above has a 160-hp Tru-Turbo engine, elliptical-cooled. Aerobike has a top speed of 115 mph, and cruises at 115 mph, averages 1600 Waterman reports. Top photo shows Waterman's aerobike in flight, the wing used from the Aerobike by an electrical engineer operating off plane's battery. Wing is supported off ground by struts, permitting one to be driven very slowly. Control system uses switching cranks at wing and fuselage junctions to eliminate need for manually disengaging controls. Car portion weighs under 1,400 lb., cruises at 55 mph. It has been driven at more than 70 mph, Waterman states. It is formed at a waterpump.

From Whittaker's
Fuel Division:

3-inch plug-in valve that cuts service time by 90%



Whittaker's 3-inch plug-in valve is standard on all new Lockheed Model 169A's. Because the body and actuator can be removed quickly and easily

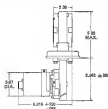
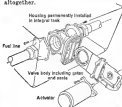
without opening the tank or disturbing the tank and line seals, it has been estimated that at least 90% of maintenance time can be saved.

Installed now in Lockheed's remarkable new Model 169A, Whittaker's gate type plug-in valve permits removal, inspection and replacement without opening the tank or disturbing the tank or line seals.

This unit consists of an integral housing (permanently attached to fuel tank structure and plumbing), and valve body assembly including valve gate, gate seals, and body. This assembly is removable from the fuel housing.

The actuator in this valve can be replaced without leakage with the adjacent plumbing filled with fuel.

The AC or DC electric motor actuator, mounted on the valve body, can be removed individually or the actuator and body can be removed altogether.



PERFORMANCE

SERVICE: Airframe and jet fuel
MOUNTING: Mounting Brackets provided for MS2613-23 and MS2613-140"U" ring packages

PRESSURE: Rated operating pressure 55 PSIG Max
TEMPERATURE: Ambient, -40°F to +140°F
Fluid, -40°F to +115°F

TEST PROCEDURE: NO. 1644

TIME: Opening at 26 volts and 70°F

Open - 1 second

Close - 1 second

ELECTRICAL DATA

18 to 25 volt D.C. motor

A.M.C. 169-140"U" receptacle provided

Pin "A" connected to open valve

Pin "B" connected to close valve

Pin "C" internally connected to Pin "D"

in full open position

Pin "E" internally connected to Pin "D"

in full closed position

Pin "F" common return for Pins "A" and "B"

Shall support 5.0 Amps. Max @ 26 volts and 70°F

Whittaker

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Wm. E. Whittaker Co., Ltd. Dept. 36
312 N. Glendale Avenue • Los Angeles 38, Calif.

Gentlemen: Please send me further information on the Whittaker 3-inch gate type Plug-in Shut-off Valve (F7N161555)

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P-4212

Aviation Week

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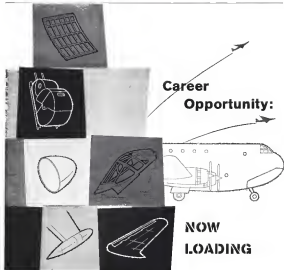
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(SEARCHLIGHT Continued on pages 126-128)

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Annual Report for Fiscal 1957

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ALTA Appreciative

The behalf of Mr. Nick Re, chairman of the board of ALTA (Association of Local and Terrestrial Airlines), the individual need appreciation, and, again, particularly in general regard, I thank you and your staff for constructive coverage of the legalism both on matters of § 229, the Coast-guard, Love Ball.

The member action of ALTA goes far in reporting the CAA sponsored action and the detailed coverage given all phases of the legalism before the Transport Edition R. S. Doty and Fred Stearns, as a constant source of strength.

Best again, thank
 Bruce P. Newman
 Assoc. of Local and Terrestrial Airlines
 Washington, D. C.

Army Economy Praised

Just finished reading your article "Army Begins Cost Cutting Program Based On 400 M. Test Results" (Sept. 5, p. 52), by Mr. J. S. Bate Jr.

I read this article with great interest since I am an Army Materiel Logistics Technician (CS USN), and a potential helicopter pilot and maintenance officer. I read an item in a well written article and very enlightening toward the problem encountered in the field of aviation when new equipment is put into service.

I highly recommend that all personnel concerned with Army Aviation review Mr. Bate's fine article. I further recommend that Mr. Torgler do the same, to ensure that his, too, may have some children as being well advised by the U. S. Army, New York program.

A salute to the TATRA for their support and assistance and participation with the H37A helicopter. Also, a salute to a deserving program—Mr. Bate.

Respect M. M. Nixon
 WJUG, U. S. Army Reserve
 1716h Third Street "Gd" B1
 Mobile, AL

Scores ATC System

Concerning the "Handcuffing in the Air" by Mr. Minnow (AW July 15, p. 116)—a true, albeit less neutral, article, but knowledge of current possibilities, and past history of the ATC system has a few glowing statements.

As a student pilot and such I am in risk the safety of passengers and myself by knowing areas in which I am being left on my own. However, the fact of the matter is Air Force primary training schools have developed restricted or certain areas, yet most are started on or only soon after emergency stage at altitude. These primary training are using T24s, the only type of aircraft that approach that of the Coast.

Mr. Minnow did not consider the difference between 1 to 40 mph and 1 to 100 mph in Los Angeles to Phoenix and other

Active Week continues the opinion of its readers on the issue raised in the previous editorial column. Address Editors at the Editor, Aviation Week, 100 W. 42 St., New York 36, N. Y. If you have letters under 500 words and give a complete identification. We will not print anonymous letters, but names of writers will be withheld on request.

when a matter of public interest. Evaluation is a matter of five, seven, good or even aircraft travel at half mile, speed or less and have only four hours training stage or less.

Flight time of 5 to 30 min may be a soft VFR operation, while 1 to 50 min may be a full landing and take off, 50 min to the top and 10 to 20 min.

CAA has no office on statistics to which it will control jet or other traffic. My reader finding in that statistics is divided into flight operating without control area, even direct flight as affected response for those parties which even in landing controlled airspace.

The only, making of the control taking control the action, now formally completed, uncontrolled. CAA is establishing in first step, control of the entire continental airspace at altitude of 74,000 ft.

It is a step plan which has made the needed airport position aware and large proportion. The step needed, will benefit military traffic the most since only a handful of active transcontinental flight jet to 74,000 ft. Military above 74,000 ft. are prohibited to use certain.

The Grand Canyon space was most certainly not a... to inevitable danger to the attempt to control modern air traffic with a system designed for the DC3's.

Quite obviously no attempt at all made in control traffic which shifts focus around the perimeter of controlled airspace, the official accident report makes quite clear the point that ATC issued no responsibility for control or controlling traffic behavior in formation at the point of the accident.

While it is true we needed more radar systems and that there may have been some loss of equipment in government, but appropriate action, and other factors which have retarded its early adoption, no more knowledge, their flight. CAA has been working steadily in order at which Agency National for over 30 years which, inevitably, is approximately half the life of the entire ATC system. Within the last five years and the new equipment were added sophisticated radar and some military RANDONs have been brought into the picture for control of traffic in some areas.

However, it is most unfortunate that no money people set it to take pilot slots at that proportion. Apparently there are still major impediments to be known what for (operator) problems are and then by to help him out. No one has any more direct and practical

knowledge of what these problems are than the working management plane. It's don't these breakdowns at them. If these conditions seem to give one person for their problem with a jammed eye, it is only because so many remarkable ideas have come through the mill.

T. C. Barrow
 Seattle, Wash.

No Recollection

We find that our most statement on Howard L. Minnow's letter "Safety Editor" (p. 115) is your Sept. 2 issue.

It is interesting to note Mr. Minnow's lack of interest and knowledge concerning the B15.

It is a check on advance of our large search and very useful data.

We cannot seem to recall our statement "NAA jet bomber put into production. It is a fact the B-45 did not become the world's fastest jet bomber."

The statement, hanging from the B-45 sub, states of the most capable bomber being developed. You will note that these recalled misstatements or under state on being issued to all the new readers' boards.

We will look forward to the continued looking back, since in the AW, it needs strengthening, like the first word made in the B-55 (with considerable) doing later than any bomber thus far.

J. V. Gannon
 Sheriff, Greater Ft. Worth Express
 Volapagos, Fla.

World Stopper

Re H. L. Minnow's "Safety Editor" letter (AW Sept. 2, p. 115), tell Mr. Minnow that if he will stop the world for not an aviation writer will get off.

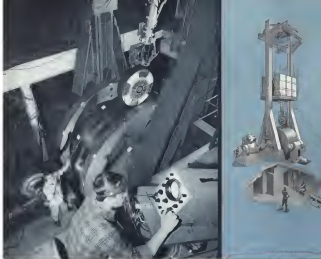
E. G. Lutz, Jr.
 Andrews, Calif.

A4D Forgings

I wanted Mr. Stone's article on the Douglas A4D-1 Skyhawk (AW Aug. 28) very much as I was working as the Equipment Section of Engineering at Douglas D1 Skunk when the first Skyhawk was built. This year, he says that the Skyhawk's design should be credited for the record.

On p. 51 he states that forgings were not used in the A4D-1. In fact he failed to say that "forgings were not used because of their strength weight ratio." In the end paragraph Mr. Stone says that the nose is secured with two brackets. If he stands on those two brackets on the production airplane he would find two things. I know, because I designed the forgings to replace the steel brackets on the first experimental A4D.

Ken F. Gannon
 Engineering Department
 U. S. South Atlantic
 Miami International Airport
 Miami, Fla.



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